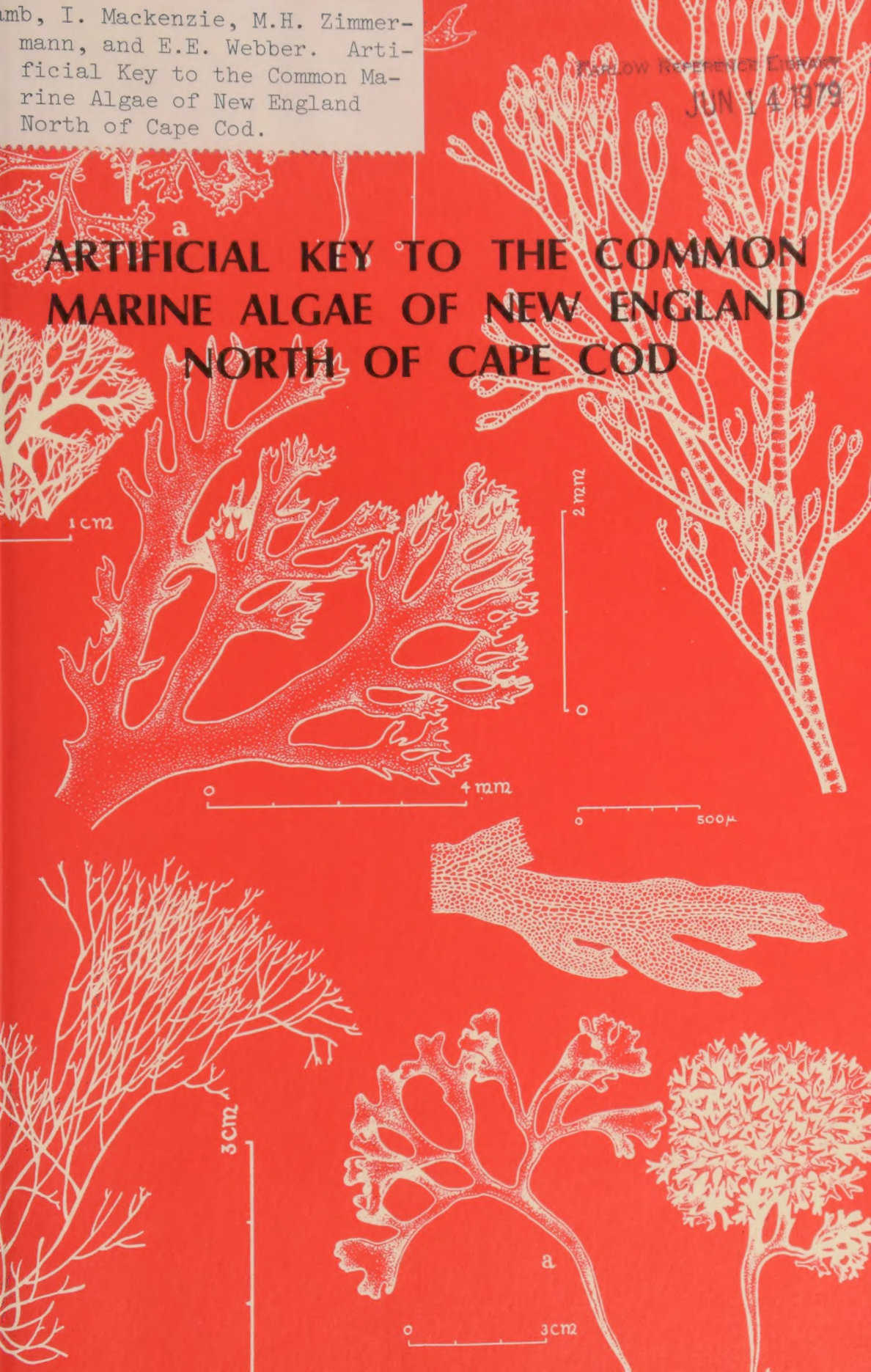


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ARTIFICIAL KEY TO THE COMMON MARINE ALGAE OF NEW ENGLAND NORTH OF CAPE COD



**ARTIFICIAL KEY TO THE COMMON
MARINE ALGAE OF NEW ENGLAND
NORTH OF CAPE COD**

By

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With drawings by

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Farlow Herbarium, Harvard University
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INTRODUCTION

Marine algae, or seaweeds, encompass a group of plants typically of great diversity in size, form, structure, life history patterns, and in pigmentation. The importance of seaweeds lies in the fact that they are primary producers in the complex and extensive food-web of the marine environment. These plants, like their green counterparts of terrestrial habitats, are able to utilize carbon dioxide and other chemical nutrients from the surrounding water, manufacturing from these elements the complete array of numerous organic compounds necessary for their life processes. The energy from these organic materials eventually becomes available by various means to other organisms in the marine ecosystem. Some green plants, perhaps locally designated as "seaweeds" (e.g. eelgrass - *Zostera marina* L.) also function in the primary producer capacity. However, since eelgrass is a flowering plant and not an alga, it is not included in the key (but see p. 53).

Many seaweeds are of considerable economic importance, their products finding use in a wide variety of industries. A few such industries would include pharmaceutical, agar, dairy, rubber, textile, foods, and fertilizer. For a thorough discussion of these and other industries, along with the plants involved, we refer the reader to Chapman's "Seaweeds and Their Uses".

Botanists have classified marine algae into major groups (phyla) principally according to their pigmentation, for this criterion reflects underlying and fundamental biochemical differences between these plants. Along with other features, therefore, the complement of pigments possessed by a given plant has withstood the test of time as a valid basis for determining natural relationships between members of such a diverse group of marine organisms. Thus, it is apparent even in a cursory examination of these seaweeds along the shore at low tide that some algae are green (Chlorophycophyta), some brown (Phaeophycophyta), others red (Rhodophycophyta), and still others are usually bluegreen in coloration (Cyanophycophyta). There are additional groupings of marine algae, but they are beyond the intent of this book.

Seasonally, there is some variation in relative abundance of these four major groups of seaweeds. Greens and reds dominate generally during warmer weather, browns are most abundant during the colder months, while cyanophytes are equally conspicuous throughout the year. But, one can locate species of each group at virtually any time of year.

The purpose of this field guide is to provide the reader with a convenient means to the identification of selected marine algae of the New England coast, north of Cape Cod to adjacent Canadian waters. While the use of technical details and scientific language is necessarily unavoidable, we have kept such usage minimal in order to enhance the utilization of this book. Accordingly, we intend this work to be informative for persons with a general interest in the marine flora; further, we hope to sharpen the curiosity of those individuals seeking additional and more detailed knowledge about the extended field of marine botany. The majority of plants contained in the key are identifiable macroscopically or by the use of a hand lens.

Attached plants which are both macroscopic in habit and especially common in occurrence along the northeastern coast of North America are emphasized intentionally. Yet, a few taxa of microscopic dimensions are included for several reasons. Some are ubiquitous along the shore throughout the year (e.g. *Cladophora*, *Rhizoclonium*); others exhibit a seasonal dominance and are thus recognizable "en masse" for a short period of time (e.g. the spring bloom of *Ulothrix*); still other microscopic algae are either an integral part of or are frequently the sole component of a discrete biological zone on the sea shore (e.g. the "black zone" of *Calothrix*).

The majority of species descriptions are accompanied by line drawings or photographs. These illustrations were prepared almost exclusively from living specimens. Most of our drawings were prepared by Priscilla Fawcett of the Fairchild Tropical Garden in Miami, Florida. However, Figures 15, 19, 22, 49 and 51 were done by Martin Zimmermann. In addition, our key has been "class tested" for several years by students of the Marine Science Institute of Northeastern University, Suffolk University, and Harvard University.

The algae mentioned in this book represent but a small fraction of the essentially 600 taxa known for the northeastern coast of North America. This key often goes only to the generic level. Anyone interested in specific identification will find Taylor's book essential. The reader is encouraged to look at the bibliography and consult books and papers listed therein. Numerous problems relating to many of these plants await the attention of the marine phycologist. We anticipate that this field guide will stimulate the interest required to undertake and solve these problems through much needed studies.

The authors would appreciate hearing from readers who find errors in this booklet, or might have any other comments or suggestions. Please address your correspondence to Martin H. Zimmermann, Harvard Forest, Petersham, Massachusetts 01366.



Fig. 1 *Leathesia difformis* (L.) Aresch. This alga is most commonly found growing on *Chondrus* either at the lower intertidal level, or in the larger and deeper mid-shore tide pools. It is rarely attached to the stony bottom of smaller tide pools near low tide mark. The spherical to subspherical brownish thalli are composed microscopically of numerous branching filaments. "The gelatinous balls which this species forms are found growing in large quantities at low-water mark, and are sometimes called potatoes by the unromantic dwellers on the shore" (Farlow, 1882, 1891, p. 83).

- | | | |
|----|--|----|
| 1 | Thallus hollow, subglobular to tubular, or with hollow parts | 2 |
| 1* | Thallus without hollow structures or parts | 13 |
| 2 | Thallus subspherical, brown, lumpy, consisting (under microscope) of adnate branched filaments | |
| | <i>Leathesia difformis</i> (Fig. 1) | |
| 2* | Thallus elongated | 3 |
| 3 | Thallus hollow and tubular throughout (or at least in thicker branches or towards the base) | 4 |
| 3* | Thallus solid but with specialized hollow bladders. . | 12 |

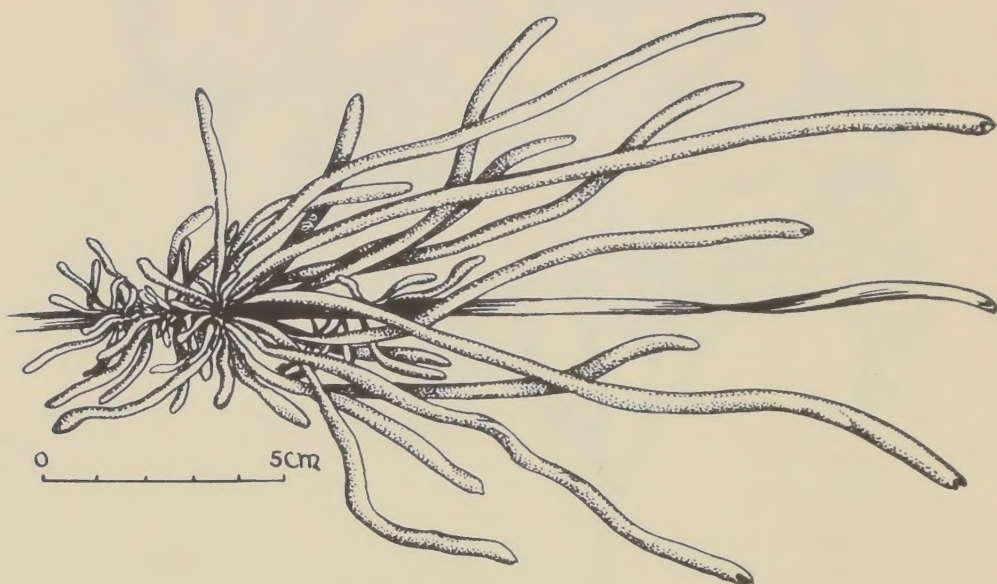


Fig. 2 *Phaeosaccion collinsii* Farlow. This rare plant was described initially from Nahant, Massachusetts, where it occurs epiphytically on eelgrass (*Zostera*) during March and April. This alga is intermittently distributed northward into the Canadian Maritimes, with eelgrass as its most common substrate. Other collections of *Phaeosaccion* are known from Greenland, Great Britain, and Norway. Because of its brown to olive-brown coloration, this plant originally was believed to be a member of the brown algae, Phaeophycophyta. Recent biochemical analyses of its pigments, however, indicate that its affinity lies with the golden brown algae, *Chrysophyceae*.

- 4 Wall of tubular thallus one cell thick; plant green or pale brown 5
- 4* Wall of tubular thallus more than one cell thick; plant brown or reddish (old specimens occasionally bleached to lighter color in *Halosaccion*) 6
- 5 Plant pale brown; grows on eelgrass (*Zostera*) in early spring *Phaeosaccion collinsii* (Fig. 2)
- 5* Plant green; grows in intertidal pools and on mud flats *Enteromorpha* (Fig. 3)

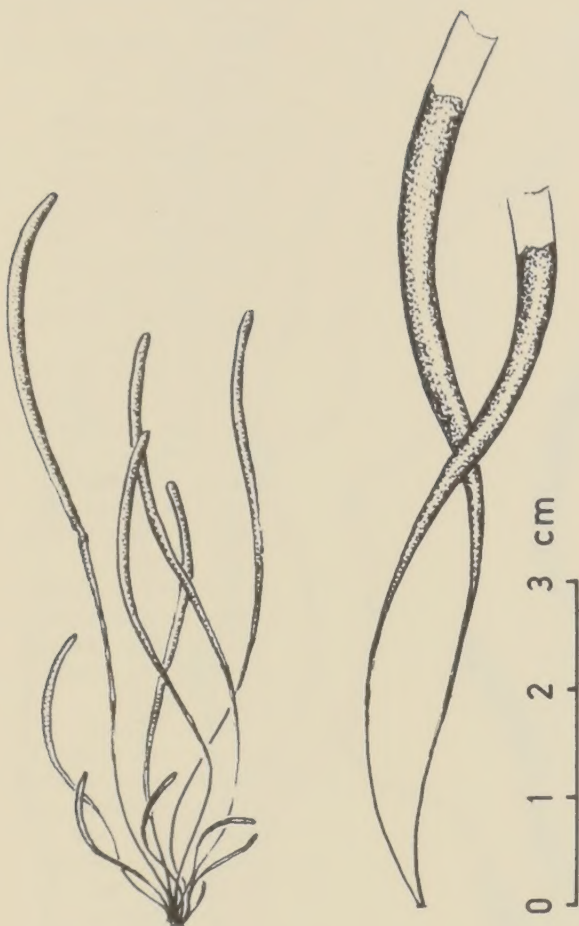


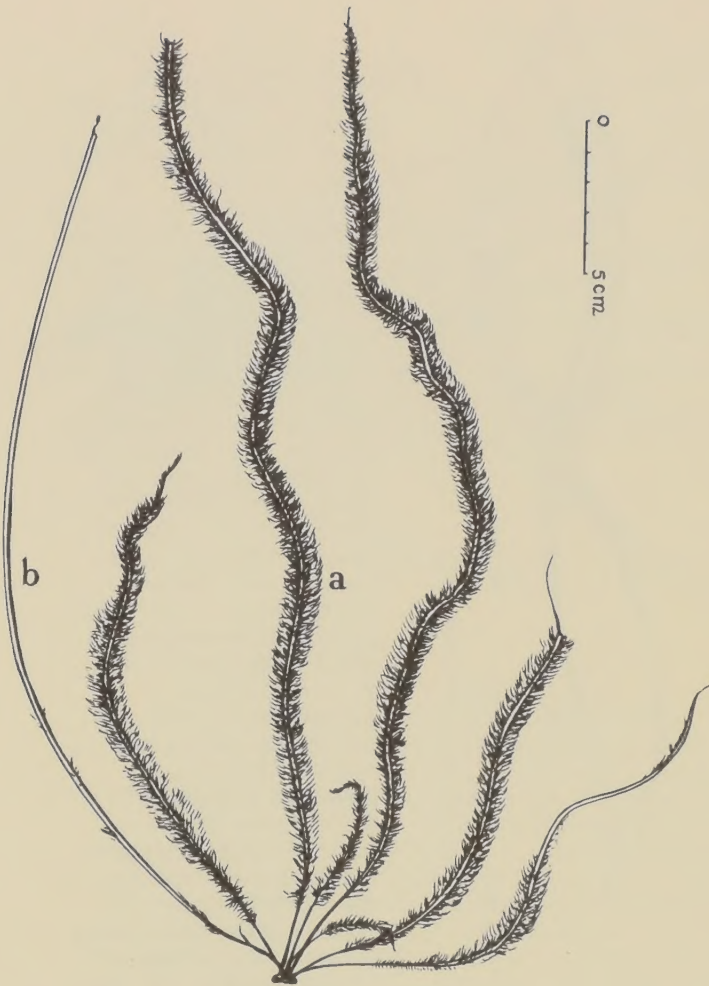
Fig. 3 *Enteromorpha* Link. These plants are among the most common green algae to be found along the shore. *E. intestinalis* (L.) Link is abundantly epilithic in intertidal pools and in the sublittoral; this species also frequents estuarine habitats. *E. linza* (L.) J. Ag., common to the intertidal zone, is recognizable when mature due to the compressed and frequently ruffled nature of its thallus; young plants of this species are illustrated here. Yet, as a group, *Enteromorpha* species represent a very perplexing assemblage to the scientist interested in determining the numerous species of this genus common to our northeastern coast. Historically, species determination has relied heavily upon gross morphological features of the plants. We now

recognize the presence of a high degree of polymorphism with this ubiquitous seaweed, and therefore have turned to more reliable criteria for species delineations. However, these criteria deal with characteristics at the microscopic level, and are beyond the scope of this key. Further, several minute plants typical to the upper intertidal zone, formerly considered as species of *Enteromorpha*, are now referred to the genus *Blidingia*. For further details see Bliding (1963), Webber and Wilce (1971, pp. 270-274), Webber (1975).

Fig. 4

Chorda tomentosa Lyngbye is a spring annual appearing in the upper sublittoral zone, often associated with *Alaria* and *Halosaccion*, and persisting until mid-summer. The plants characteristically have a dense furry coating of fine brown assimilative hairs (a) which are shed (b) in mid-summer. *C. filum* (L.)

Lamour., commonly referred to as the devil's shoestring, lacks these assimilative filaments at maturity, and is more common through the summer and into the autumn. These smooth and slippery feeling plants typically grow in clusters in the upper sublittoral where they may attain lengths of up to 5 m (commonly 1-1.5 m).



- | | | |
|----|---|------------------------|
| 6 | Thallus little or not branched, except sometimes near the base | 7 |
| 6* | Thallus branched | 9 |
| 7 | Thallus at maturity 0.5-1.0 m long; assimilative hairs, when present, conspicuous and forming a dense continuous covering | <i>Chorda</i> (Fig. 4) |
| | (See also under step 53 of key). | |
| 7* | Thallus less than 0.5 m long; hairs, if present, in small tufts, colorless, inconspicuous | 8 |

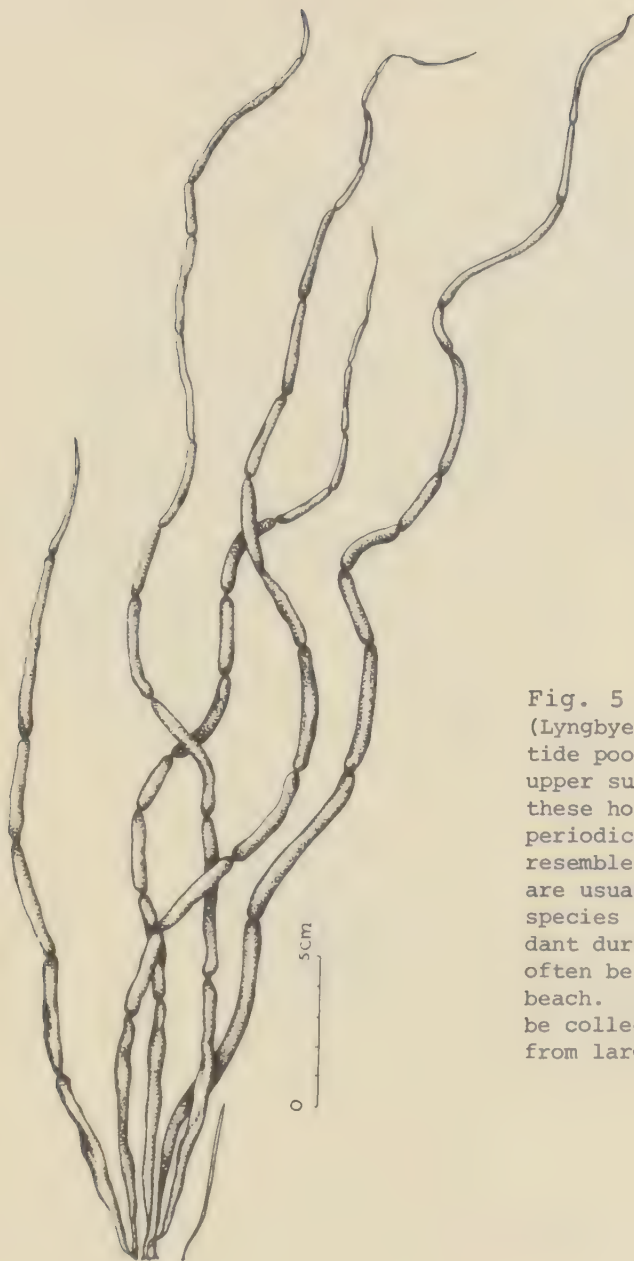


Fig. 5 *Scytosiphon lomentaria* (Lyngbye) C. Ag. is common in tide pools and on rocks in the upper sublittoral. At maturity, these hollow plants are often periodically constricted and resemble sausages. Young plants are usually unconstricted. This species is most commonly abundant during the colder months, often being cast up on the beach. It still, however, can be collected during the summer from large tide pools.

- 8 Thallus brown, when mature constricted at intervals *Scytosiphon lomentaria* (Fig. 5)
- 8* Thallus reddish (but sometimes bleached, pale), not constricted *Halosaccion ramentaceum* (Fig. 6)

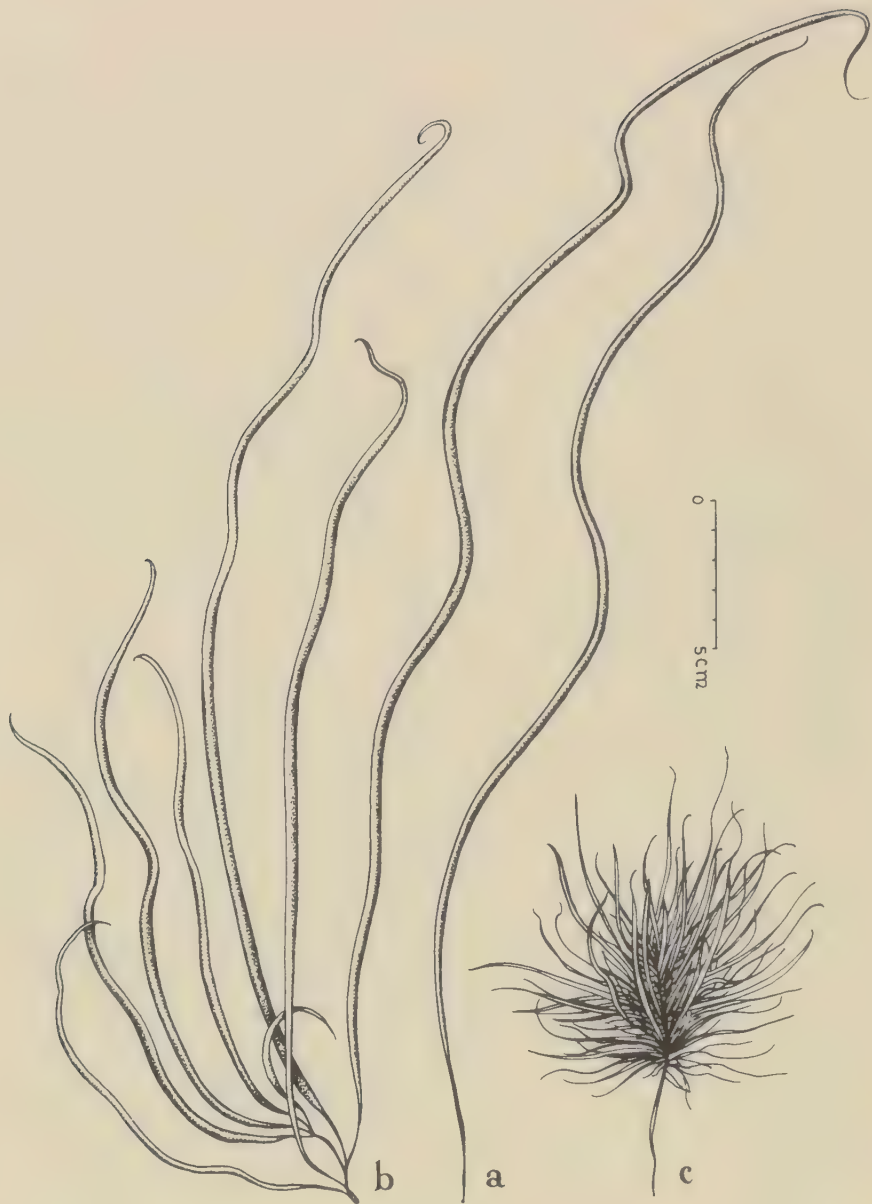


Fig. 6 *Halosaccion ramentaceum* (L.) J. Ag. grows in the upper infralittoral, associated with *Chorda*, *Alaria*, etc., and is in its best condition in spring; by early summer it begins to bleach and decay from the tips downwards. The thalli usually consist of single unbranched tubular fronds (a), occasionally there is a limited amount of branching near the base (b), so that careful distinction from *Dumontia incrassata* is necessary. Specimens growing from last year's basal parts are very heavily branched (c).



Fig. 7 *Dictyosiphon foeniculaceus* (Huds.) Grev. is a highly branched, bushy brown alga somewhat similar in general appearance to *Desmarestia viridis* (Fig. 43). Unlike the latter, it retains its brown color when taken out of water; further, it is anatomically distinct from *D. viridis*, lacking a central hole in the main branches as seen in cross section. It often grows as an epiphyte on other algae, especially *Chordaria flagelliformis*, and is common during the summer along the southern parts of the New England coast.

- 9 Plant brown *Dictyosiphon* (Fig. 7)
 (See also under step 59 of key).
- 9* Plant reddish 10
- 10 Plant soft, gelatinous, with abundant, fine, bushy
 branchlets *Gloiosiphonia capillaris* (Fig. 51)
 (See also under step 66 of key).
- 10* Plant firmer, not gelatinous, moderately coarsely
 branched or unbranched 11

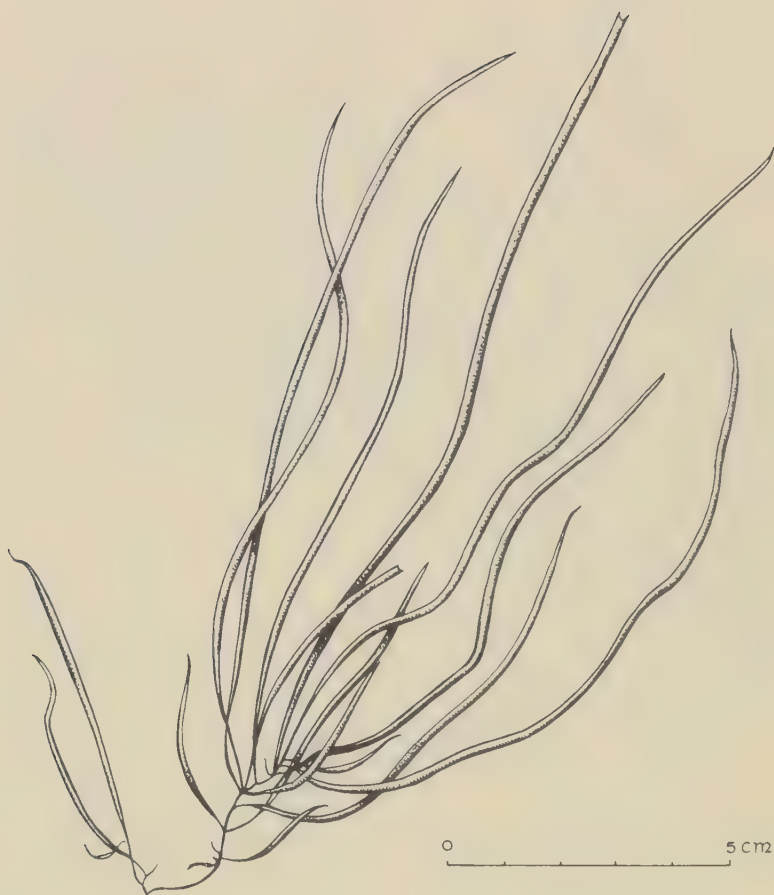


Fig. 8 *Dumontia incrassata* (Müll.) Lamour. frequently inhabits large downshore tide pools. It is a conspicuous plant, often 15-50 cm long, dull dark red but becoming yellowish when exposed to strong light. Some plants superficially resemble *Halosaccion*, but *Dumontia* is more abundantly branched; anatomically, these two genera are also distinguishable.

- 11 Plant moderately branched; inner part of thallus wall, inside the cellular chromatophore-bearing outer cortex, with longitudinal filaments
 *Dumontia incrassata* (Fig. 8)
- 11* Plant unbranched or only slightly branched in lower part; inner part of thallus wall, inside the cellular chromatophore-bearing outer cortex, with large colorless cells *Halosaccion ramentaceum* (Fig. 6)



Fig. 9 *Fucus vesiculosus* L. is commonly called "bladder wrack" or "rockweed". This species, together with *Ascophyllum nodosum*, is the most abundant large brown alga in the intertidal zone. Active reproduction occurs throughout the winter and early spring with the gametes being produced in terminal swollen structures called receptacles. Other *Fucus* species are shown in Fig. 28.

- 12 Bladders produced by inflation of portions of flat dichotomous fronds *Fucus vesiculosus* (Fig. 9)
(See also under step 39 of key).
- 12* Bladders produced at intervals along the narrow, only slightly flattened, thong-like thallus
. *Ascophyllum nodosum* (Fig. 10)



Fig. 10 *Ascophyllum nodosum* (L.) LeJolis, "knotweed", forms dense mats with *Fucus vesiculosus* throughout the intertidal zone. The reproductive receptacles of this plant are formed terminally on lateral branches during the winter. *Ascophyllum* is commonly epiphytized by dark red-purple tufts of *Polysiphonia lanosa*, a red alga which in nature is found only attached to this knotweed. It is interesting further to note that *Ascophyllum* plants always contain an endosymbiotic fungus, *Mycosphaerella ascophylli* Cotton.

13	Thallus crustose	14
13*	Thallus not crustose	18
14	Thallus brown . . . <i>Ralfsia</i> (See legend to Figs. 11 and 12)	
14*	Thallus reddish	15
15	Thallus calcified	17
15*	Thallus not calcified	16
16	Crust widespread, smooth; fertile plants with conceptacles visible as pores on the surface	
	. . . <i>Hildenbrandia prototypus</i> (See legend to Figs. 11 and 12)	
16*	Crust of small patches about 1 cm in diameter, marked with concentric lines; surface never with pores . . .	
	. . . <i>Petrocelis middendorffii</i> (See legend to Figs. 11 and 12)	
17	Crust with protuberances or branches . . . <i>Lithothamnium</i> (Fig. 11)	
17*	Crust without protuberances or branches . <i>Clathromorphum</i> and <i>Phymatolithon</i> (Fig. 12)	



Figs. 11 and 12 The differences of crustose species are difficult to show in habit drawings. However, careful use of the key will separate them with relative ease.

Ralfsia verrucosa (Aresch.) J. Ag. is a perennial brown crust common to intertidal rock pools and to stones in the sublittoral. Young plants resemble "splotches of brown paint" on the rocks. Older plants are quite brittle and frequently exhibit several concentric growth layers. Microscopically, the plants are composed of short filaments which arise vertically from a prostrate basal series of cells.

Hildenbrandia prototypus Nardo generally resembles *Ralfsia* in its crustose habit, except that its color is dark to brownish red. The plants are commonly epilithic in intertidal pools. When fertile, these crusts exhibit small reproductive pores called conceptacles scattered on the surface.

Petrocelis middendorffii (Rupr.) Kjellm. grows in the sublittoral as dark purple-red patches on rock. The thallus, although crustose, is thicker and has a more velvety appearance than that of *Hildenbrandia*.

Lithothamnium (Fig. 11, on a mussel shell), *Phymatolithon* (Fig. 12, on a stone) and *Clathromorphum* are the commonest genera of calcified encrusting red algae found in our region. Their exact identification as to species is difficult, requiring decalcification with acid, embedding in paraffin, and sectioning with a microtome. The *Lithothamnium* species, e.g. *L. glaciale* Kjellm., are recognizable by the branches or protuberances on the thallus; the other genera are either smooth (*Clathromorphum circumscriptum* (Stroemf.) Foslie) or with curved ridges on the surface (*Phymatolithon laevigatum* (Foslie) Foslie). *Lithothamnium glaciale* occurs only in the infralittoral; *Clathromorphum circumscriptum* and *Phymatolithon laevigatum* grow not only in the infralittoral but also in intertidal pools. For further information on this difficult group, see the studies of ADEY (1965, 1966).



Fig. 13 *Corallina officinalis* L. is the only jointed calcified red alga common to our area. The plants consist of an upright series of branching axes which produce a tufted growth habit. *Corallina* can be readily collected from downshore tide pools and from rocks in the sublittoral. The plants are frequently cast up on the shore following stormy weather.



Fig. 14 Macroscopic illustration of the colonial diatom *Amphipleura rutilans*. This diatom produces long, brown, gelatinous tubes in which the cells are contained. Thus, the plant mass is readily visible as numerous dark brown, slippery "filaments". It is epiphytic on a variety of filamentous algae in tide pools. *Amphipleura* is also known from estuaries where it frequently forms dark brown patches on intertidal mud.

- 18 Thallus of articulated calcareous segments . . . *Corallina officinalis* (Fig. 13)
- 18* Thallus not calcified 19
- 19 A colonial diatom *Amphipleura* (Fig. 14)
- 19* Thallus consisting of branched or unbranched uniseriate filaments, not corticated 20
- 19** Thallus of various form and structure, but not consisting exclusively of uniseriate filaments, i.e. multiseriate or corticated. *Pylaiella* (step 32 of key) may occasionally have a few longitudinal septa in some of the main filaments. In *Isthmoplea* (step 56 of key) the main filaments are regularly multiseriate . . . 33

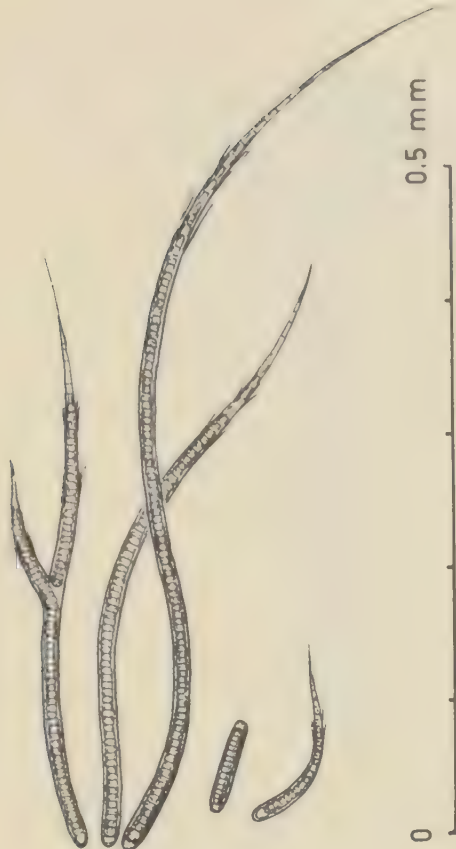


Fig. 15 *Calothrix crustacea* (Thur.) Fan is a widely distributed filamentous blue-green alga common at and immediately above high tide level. The alga may encrust bare rock, lending a black appearance to its substrate, or it may grow submerged in high level rock pools and crevices. In latter situations, the plants form extensive greenish blue-black turfs 2-4 mm thick during the summer months. It has been shown recently that this species fixes atmospheric nitrogen, subsequently releasing N-containing compounds into the environment; these compounds are then incorporated within the thalli of other marine algae. *Calothrix crustacea* is polymorphic; several growth forms are recognized by some phycologists. Frequently associated with *C. crustacea* are macroscopic brown to yellowish-brown patches of

another (microscopic) blue-green, *Entophysalis deusta*. Detailed study of *Calothrix* and other upper shore blue-green algae requires the use of a microscope. For more information see Fan (1956), Drouet (1968) and Webber (1971, 1974).

Ulothrix flacca (Dillw.) Thur. is most abundant during the Spring and early Summer. Macroscopically, the massed filaments of this species resemble dark green "strings" on intertidal rocks, particularly in the *Fucus-Ascophyllum* zone.

20	Filaments unbranched or rarely branched; plant green or blue-green	21
20*	Filaments normally much branched	26
21	Photosynthetic pigment blue-green, diffuse in the protoplasm	<i>Calothrix</i> (Fig. 15)
21*	Photosynthetic pigment grass-green, localized in chloroplasts	22
22	Cells with a single, parietal, bracelet-shaped chloroplast . . .	<i>Ulothrix flacca</i> (See legend to Fig. 15)
22*	Cells with reticulate or fragmented chloroplasts. .	23

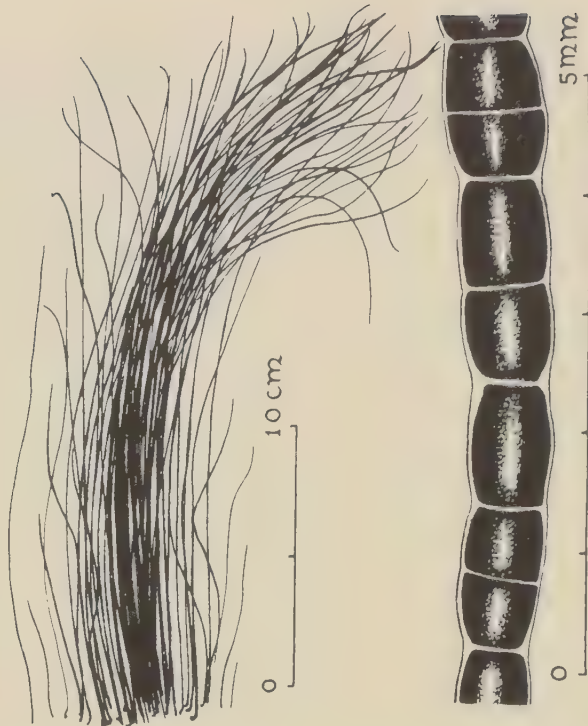


Fig. 16 *Chaetomorpha melagonium* (Web. & Mohr) Kütz. grows in the upper sublittoral, and in downshore tide pools. The plants are readily recognized due to their very stiff and straight growth habit. The cells are large, being visible to the naked eye. Coloration of these filaments is dark green, and they tend to occur in tufts attached to rock. Some plants from estuaries may attain lengths of 30-40 cm.

Urospora wormskjoldii (Mert.) Rosenv. is a plant of the mid to lower intertidal zone. It resembles *Chaetomorpha* in general habit, but its texture is softer and the cells are more constricted (like beads on a string) than in *Chaetomorpha*.

- | | | |
|-----|--|---|
| 23 | Filaments attached at the base | 24 |
| 23* | Filaments free floating or entangled, (attached initially) | 25 |
| 24 | Rhizoids, if present, produced only from the basal cell; filaments for the most part not or only slightly constricted at joints . . . <i>Chaetomorpha melagonium</i> (Fig. 16) | |
| 24* | Rhizoids produced from several cells near the base: filaments strongly constricted at joints, with bead-like cells | <i>Urospora</i> (See legend to Fig. 16) |

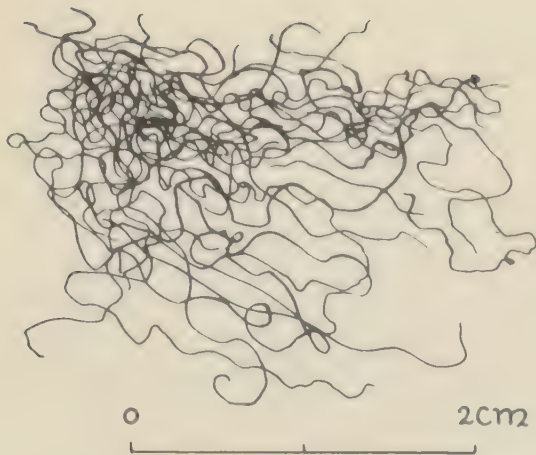


Fig. 17 *Chaetomorpha linum* (Müll.) Kütz., with characteristically twisted and crisped filaments, is usually entangled among other algae, like *Chondrus*, and commonly cast up on the beach after storms.

Rhizoclonium Kützing. Several species are common to our northeastern area, but a microscope is needed to differentiate them. *R. tortuosum* Kütz. grows on rocks in the intertidal zone; the plants are dark green and frequently twisted. During the summer, this species also exists in deeper tide pools where it often grows up from the base of the pool and eventually forms floating mats of green filaments. Other species of *Rhizoclonium* can be encountered in estuaries and adjacent salt marshes throughout the year.

- | | | |
|-----|---|--------------------------------------|
| 25 | Filaments 70 μ or less in diameter | <i>Rhizoclonium</i> |
| | (See legend to Fig. 17). | |
| 25* | Filaments coarser, 150-300 μ in diameter. . | <i>Chaetomorpha linum</i> (Fig. 17). |
| 26 | Color greenish, usually grass-green | 27 |
| 26* | Color reddish or brownish | 28 |
| 27 | Lower parts of plants $\pm$ held together by curved or hooked branchlets or by downgrowing rhizoidal branches | <i>Spongomorpha</i> (Fig. 18) |
| 27* | Filaments not held together by special curved, hooked or downgrading rhizoidal branches | <i>Cladophora</i> |
| | (See legend to Fig. 18). | |

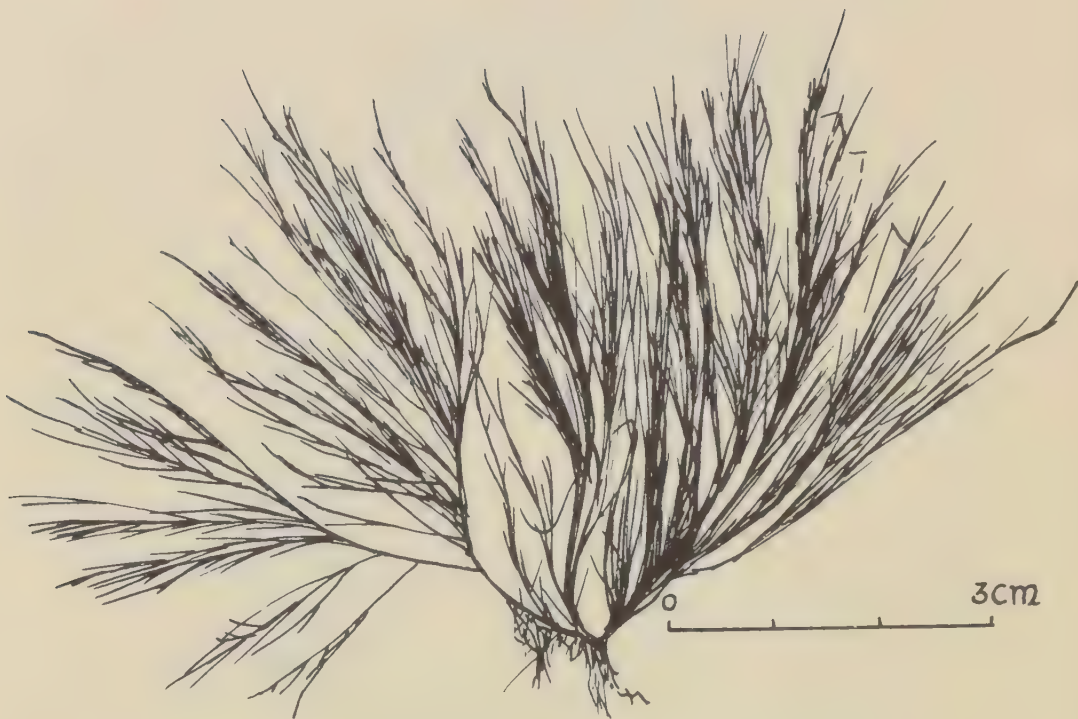


Fig. 18 *Spongomorpha arcta* (Dillw.) Kütz, is common on rock in the upper sublittoral and lower littoral tide pools. This branching filamentous plant can be mistaken easily for a *Cladophora* species except for the presence of a few downgrowing rhizoidal branches near its base. *S. lanosa*, prevalent in tide pools, has an abundance of these rhizoidal branches such that they interweave the basal portions of the plant into rope-like strands. Another species located in tide pools and in the sublittoral is *S. spinescens*, having recurved or hook-like branchlets which also aggregate the filaments into rope-like strands.

Cladophora Kützinger has a branching filamentous habit, but lacks the rhizoidal and hook branches present in *Spongomorpha*. Speciation in *Cladophora* is very complex, and a precise delineation of all species present in our flora is not possible at this time. The plants are very abundant during the summer; they may be attached to rock, wood, other substrates, or they may be free-floating. They are common both to the rocky shore and to estuaries and bays alike.



Fig. 19 *Antithamnion floccosum* (Müll.) Kleen is a plant of the sublittoral zone, where it grows rather abundantly during the spring and summer. It is a most delicate red alga; the determinate ultimate branchlets are regularly opposite in arrangement, as can be seen under low microscopic magnification. The illustration on the left is a shadowgraph of a 9 cm tall specimen. The drawing on the right shows the tip of a young 1 cm tall specimen. Other species can be determined using Taylor's (1957) book.

- 28 Plant reddish; growth terminal, from an apical cell . 29
- 28* Plant brown or rusty-brown; growth intercalary, not
from an apical cell 30
- 29 Final branchlets opposite *Antithamnion* (Fig. 19)
- 29* Branching irregularly alternate throughout . . *Trailliella*
intricata (Fig. 20)



Fig. 20 *Trailliella intricata* (J. Ag.) Batt. is a rather uncommon alga generally; locally it may be quite abundant (e.g., Cape Ann, Mass.). The plants form compact, puff-like tufts attached to rocks and other algae in the sublittoral zone; it has even been seen on the carapaces of small spider crabs which wander among the algae at the same level. Sometimes plants are present in tidal drift material. Reports of *Trailliella* from northeastern North America have been very few (Webber, 1971, p. 284). The plants bear reproductive structures (tetrasporangia). The spores from these structures grow into the sexual generation of a plant recognized as *Asparagopsis hamifera* (Fig. 50), which is of totally different aspect. This is a striking instance of the dimorphism between sexual generations found in some of the red algae.

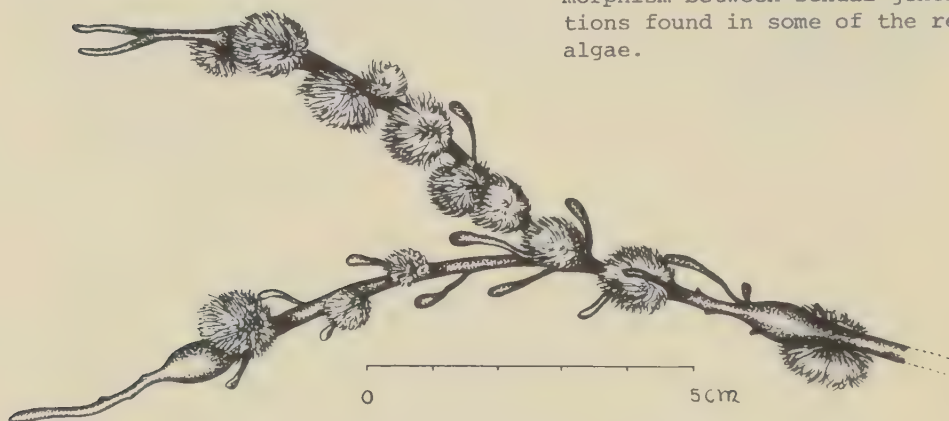


Fig. 21 *Elachistea fucicola* (Vell.) Aresch. is readily recognized due to its occurrence as an epiphyte mainly on *Fucus* and *Ascophyllum*. The filaments are organized into a basal cushion and an upright series, the entire mass resembling a small spherical tuft of brown growth. The upright filaments rarely exceed 1 cm in length.

- 30 Filaments all more or less alike 31
 30* Filaments of two kinds: crowded short moniliform
 filaments at base, and long straight non-constricted
 filaments extending out above
 *Elachistea fucicola* (Fig. 21)

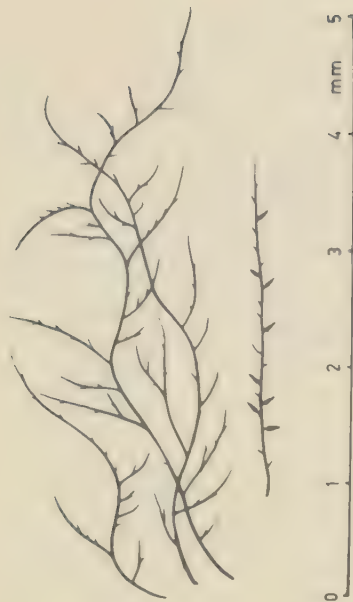
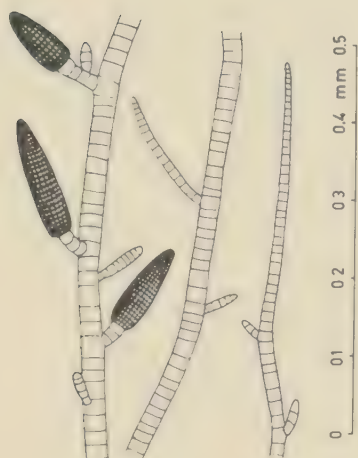


Fig. 22 *Ectocarpus*. Along with *Pylaiella*, these plants are probably the most common brown filamentous algae to occur in our area. Distinctions between these two genera are made with certainty only at the microscopic level, as is true with species of *Ectocarpus* itself. *E. confervoides* var. *confervoides* (Roth) Kjellm. and *E. confervoides* var. *siliculosus* (Dillw.) Kjellm. can be collected from tide pools and the sublittoral where they usually are epiphytic upon other algae. On the blades of *Laminaria* sp. or *Saccorhiza* sp. one frequently encounters *E. fasciculatus* (Griff.) Harv.



Pylaiella littoralis (L.) Kjellm. is a brown filamentous alga commonly encountered attached to *Fucus*, *Ascophyllum*, or other large algae. It resembles generally the growth habit of *Ectocarpus*, and microscopic examination is necessary to distinguish these two genera.

Both figures show *Ectocarpus*.

- 31 Thallus rusty reddish or purplish-brown, forming a flat coating on the rock; no zoosporangia or gametangia produced *Bangia fuscopurpurea* (young uniseriate condition; see step 60 of key)
- 31* Thallus pale brown to dark brown, not reddish or purplish; forms free tufts on rock or on coarser algae; reproducing by zoosporangia or gametangia 32
- 32 Reproductive organs (zoosporangia or gametangia) intercalary in the filaments *Pylaiella littoralis* (See legend to Fig. 22)
- 32* Reproductive organs (zoosporangia or gametangia) lateral or terminal on the filaments . . *Ectocarpus* (Fig. 22)



Fig. 23 *Porphyra umbilicalis* (L.) C. Ag. has a membranous or sheet-like growth habit. Although a red alga, the plants are often olive to purple-brown. The plants attach to rocks and wood in the intertidal and the uppermost sublittoral during the spring and summer. While *P. umbilicalis* is a one-cell thick sheet, another species, *P. miniata* (L.) C. Ag., is two cells in thickness; these thalli are large and typically rosy-red in color. The illustration shows *P. miniata* as an epiphyte on *Chondrus*.

- 33 Thallus entirely sheet-like or membranous, only 1-2 cells thick, not veined 34
- 33* Thallus cylindrical or flattened; if leaf-like, then with veins 36
- 33** The green alga *Prasiola stipita* is identifiable at this point. It can be located readily just above high tide level (the barnacle zone) where its flat, 1-2 mm wide thalli typically grow both on rock surfaces and in small cracks and crevices. The plants resemble "parsley flakes" which have been sprinkled on these high intertidal rocks.
- 34 Thallus green 35
- 34* Thallus rose-red, reddish or brown. . *Porphyra* (Fig. 23)

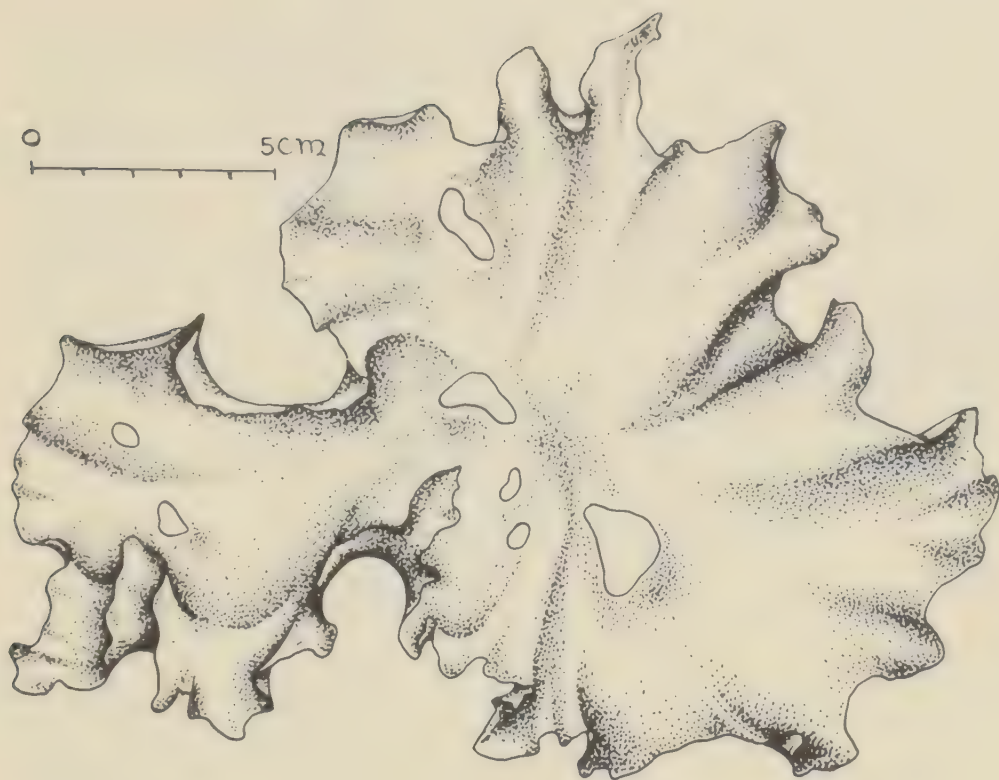


Fig. 24 *Ulva lactuca* L. The sheet-like thallus of the "sea lettuce" is two cells thick, coarse to the touch, and frequently attains a length of 30-40 cm. At maturity the plants may or may not be perforate. *Ulva* is equally ubiquitous throughout the upper sublittoral and in tide pools. Young plants may superficially resemble *Monostroma* sp. or a small *Enteromorpha linza*, and care is required at this stage to distinguish these plants. *Ulva*, like *Enteromorpha*, exhibits excessive growth in coastal areas subject to nutrient inflow. It is not uncommon to see "bloom conditions" of *Ulva* in polluted bays and estuaries.

- 35 Thallus 2 cell layers thick *Ulva lactuca* (Fig. 24)
 35* Thallus 1 cell layer thick *Monostroma* (Fig. 25)

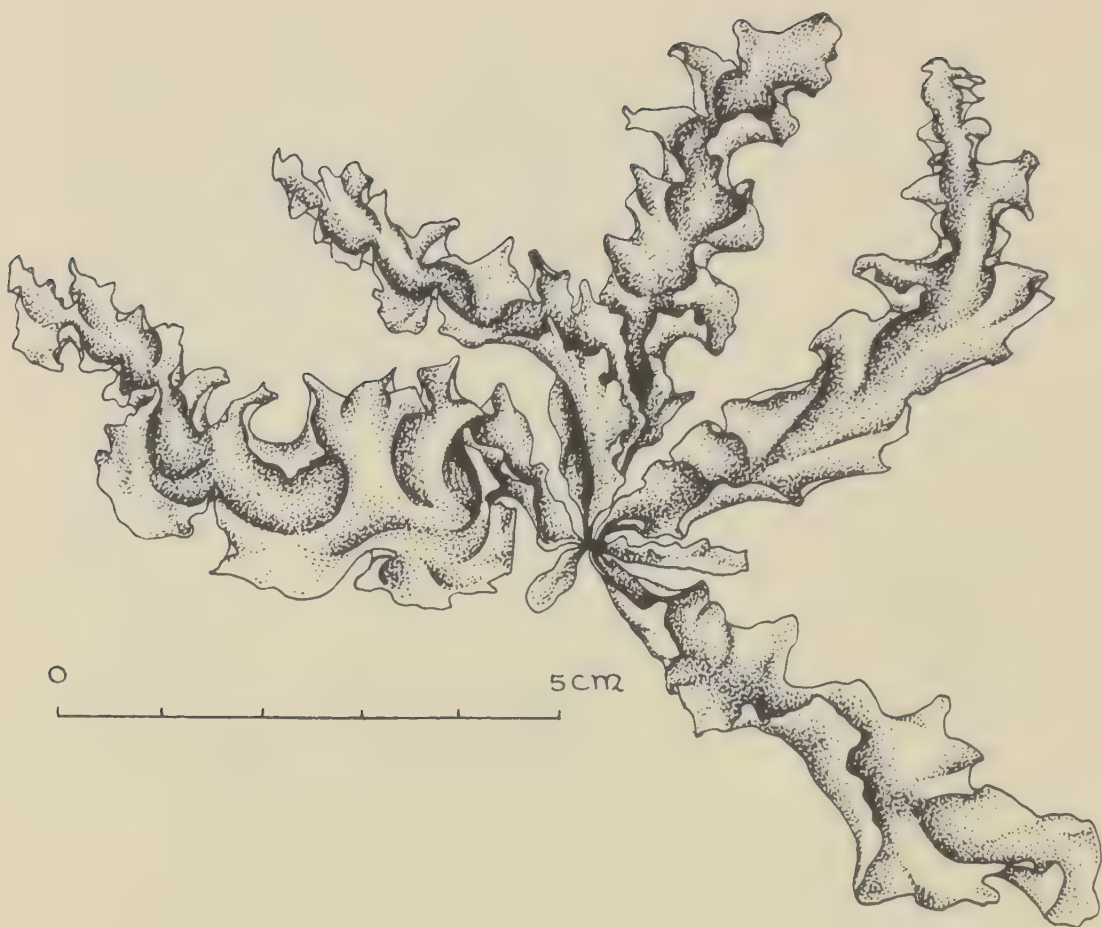


Fig. 25 *Monostroma* Thuret. Several species of *Monostroma* grow along our northeast coast, their presence and abundance extending from late autumn through the winter and into early spring. The plants begin their macroscopic appearance as small sacs which eventually split into a membranous form one cell thick. Thus, they are delicate to the touch. Species determinations rest largely upon microscopic characteristics, but some species can be recognized otherwise. For example, *M. fuscum* (P. & R.) Wittrock f. *blyttii* (Aresch.) Collins is a coarse and dark green species, one which turns brownish upon drying. A most attractive species is *M. pulchrum* Farlow, with an elongated and elegantly ruffled thallus. These plants are common in tide pools and in the upper sublittoral zone during the spring, where they may be attached to rocks or to other algae.

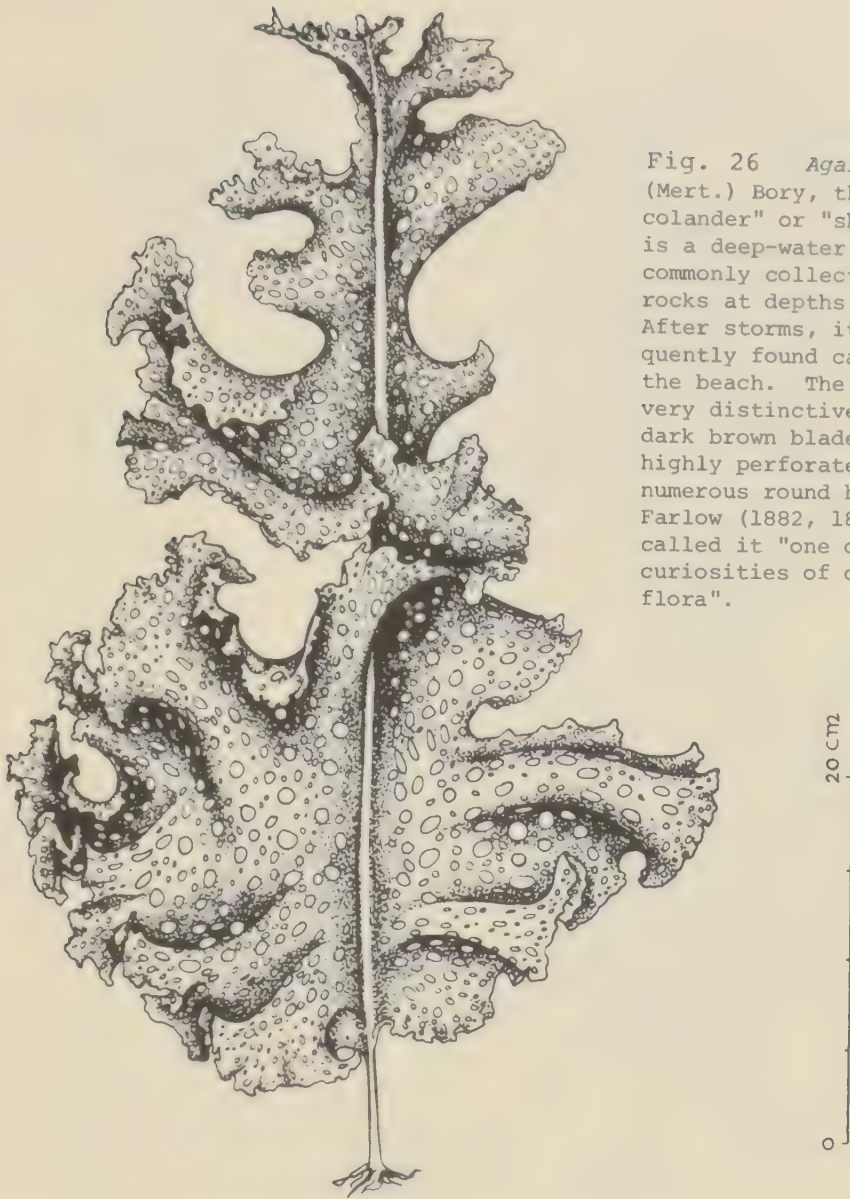


Fig. 26 *Agarum cribosum* (Mert.) Bory, the "sea colander" or "shotgun kelp", is a deep-water plant commonly collected from rocks at depths of 10-12 m. After storms, it is frequently found cast up on the beach. The alga is very distinctive with its dark brown blade being highly perforated with numerous round holes. Farlow (1882, 1891, p. 96) called it "one of the curiosities of our marine flora".

36	With midrib or veins	37
36*	Without midrib or veins	41
37	Coarse brown algae	38
37*	Small delicate red algae	40
38	Thallus a simple broad blade perforated with many holes	<i>Agarum cribosum</i> (Fig. 26)
38*	Thallus divided or branched above holdfast, not perforated with holes	39

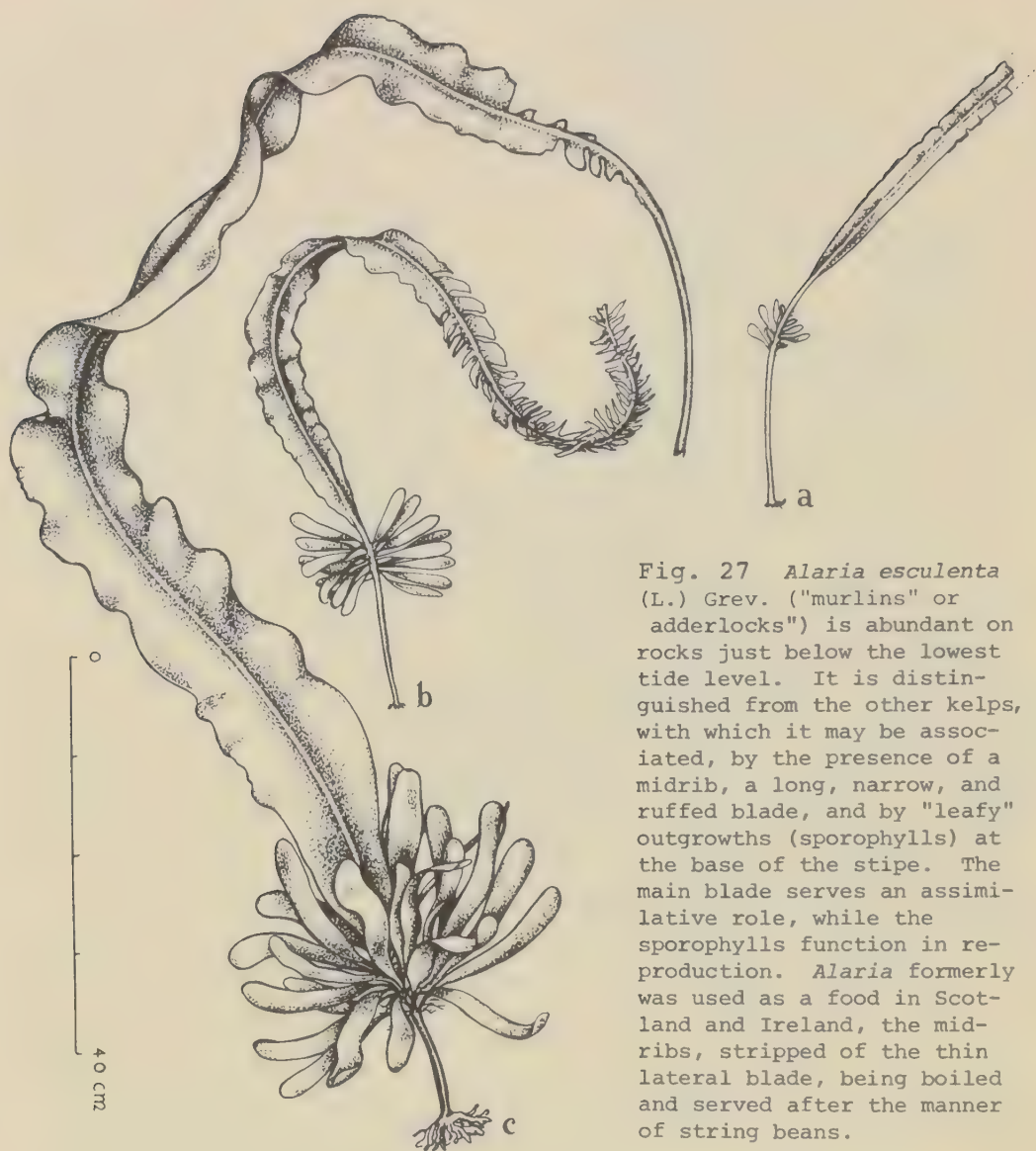


Fig. 27 *Alaria esculenta* (L.) Grev. ("murlins" or "adderlocks") is abundant on rocks just below the lowest tide level. It is distinguished from the other kelps, with which it may be associated, by the presence of a midrib, a long, narrow, and ruffed blade, and by "leafy" outgrowths (sporophylls) at the base of the stipe. The main blade serves an assimilative role, while the sporophylls function in reproduction. *Alaria* formerly was used as a food in Scotland and Ireland, the mid-ribs, stripped of the thin lateral blade, being boiled and served after the manner of string beans.

- 39 Plant consisting of a long (about 1 m) main blade and many smaller lateral blades (sporophylls) between holdfast and main blade . . . *Alaria esculenta* (Fig. 27)
- 39* Plant strap-shaped, with dichotomous branching . . .
 *Fucus* (Fig. 28, see also step 12 of key)



Fig. 28 *Fucus distichus* L. ssp. *edentatus* (de la Pyl.) Powell, unlike *F. vesiculosus* (which is shown in Fig. 9) lacks air bladders and grows further downshore, being common in the lowest intertidal and extending into the upper sublittoral zone. It is readily identified from its receptacles which are elongate, strongly flattened, and frequently bifurcate. Another taxon generally similar in size and general ecology is *F. distichus* L. ssp. *evanescens* (C. Ag.) Powell. However, this thallus is generally broader, and its receptacles are short, wide, and blunt ended. Another species, *F. spiralis* L., occurs higher in the intertidal than *F. vesiculosus*. Uppermost plants of *F. vesiculosus* often resemble the twisted thalli of *F. spiralis* in gross habit; but the latter species is monoecious, while the former is dioecious. Finally, *F. filiformis* Gmel. is a much smaller plant with very narrow axes, and occurs only in intertidal rock pools.

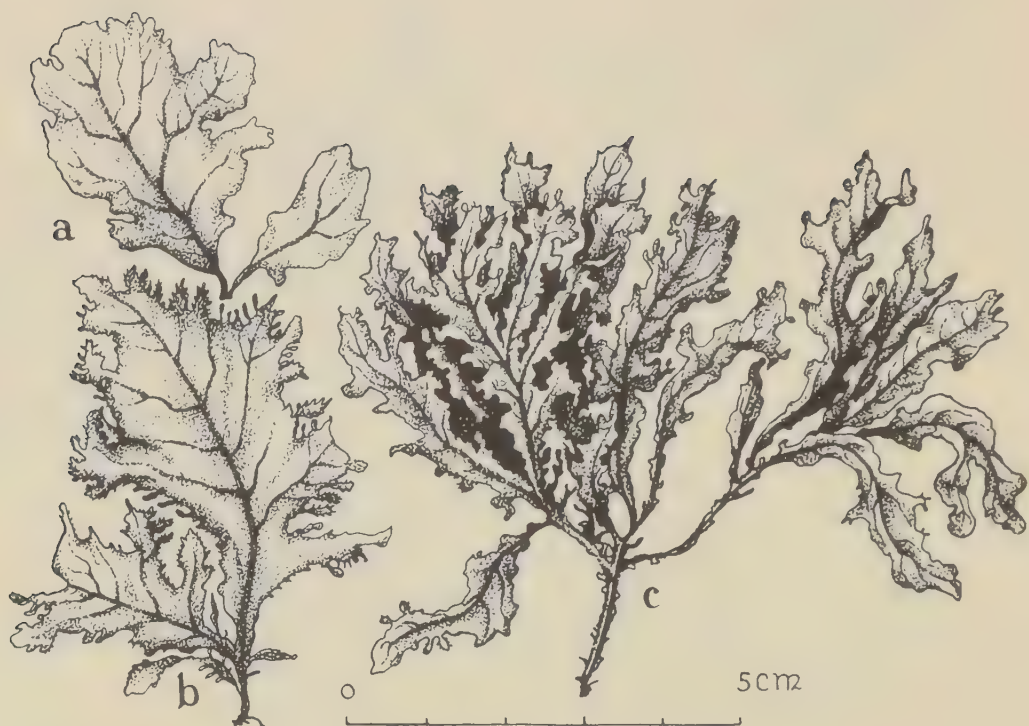


Fig. 29 *Phycodrys rubens* (Huds.) Batt. ("oak leaf") is considered by many to be the most beautiful of our local algae. Its veined and heavily crenated blades resemble an oak leaf in shape. It grows on rocks in the sublittoral, and is very often cast up on the shore after a storm. Intact and well-formed plants may be collected during the summer.

- 40 Plant leaf-like, with midrib and lateral veins *Phycodrys rubens* (Fig. 29)
- 40* Plant linear, much branched, consisting of a midrib bordered along its edges by a very narrow thin membrane *Membranoptera alata* (Fig. 30)
- 40** Plant linear, much branched, consisting of a midrib bordered along its edges by an extremely thin membrane, in older parts the membrane is almost absent, but the tips are flattened *Pantoneura Baerii* (Fig. 31)



Fig. 30 *Membranoptera alata* (Huds.) Stackh. is a small and generally inconspicuous red alga attached to larger seaweeds in the sublittoral zone. Although the axes are described as a leafy type, its thin blade is reduced to a narrow fringe along both sides of the faint midrib.



Fig. 31 *Pantoneura Baerii* (Postels & Rupr.) Kylin, a plant of northern waters, is quite abundant at Cape Ann, MA, but not at Nahant where its place seems to be occupied by *Membranoptera*. The membranous blade is more reduced than that of *Membranoptera*, but the tips are still flattened. It grows on coarser algae (*Phyllophora*, *Chondrus*, etc.) at a depth of 10-13 meters in the lower *Laminaria* and upper *Agarum* zones. It seems to be a perennial but produces lush new growth during the summer months (see Lamb & Zimmermann, 1964).

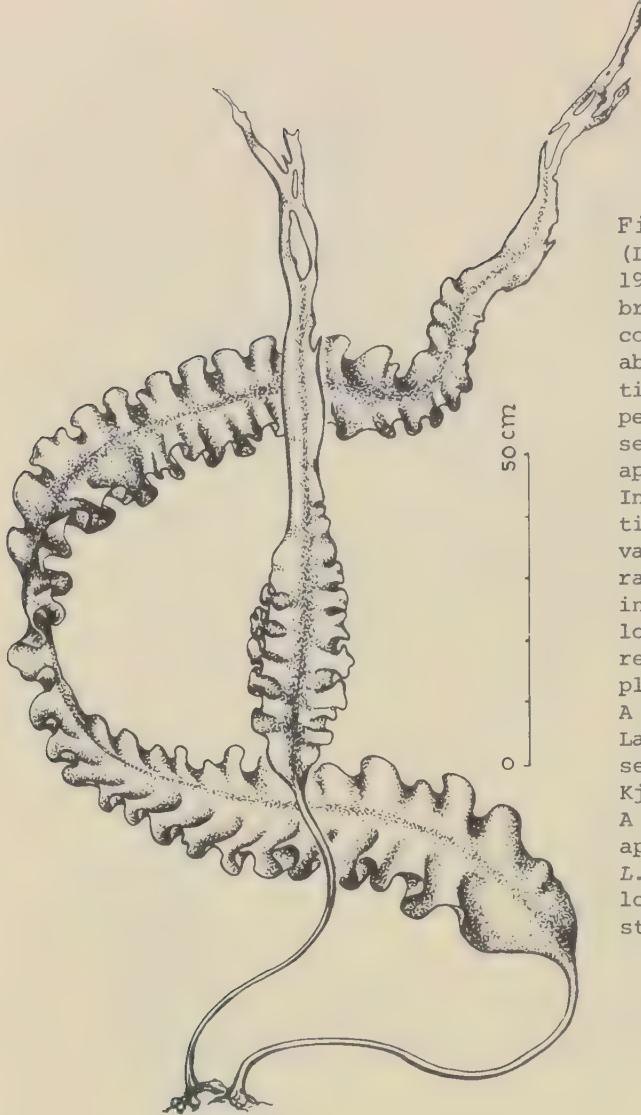


Fig. 32 *Laminaria saccharina* (L.) Lamour. (sensu Wilce, 1965) is the dominant large brown kelp of the New England coast, forming dense beds from about 2 to 13 meters below low tide mark. The plants are perennial with a life span of several years; young plants appear each spring about April. In a given population at that time, one can distinguish various age groups of plants, ranging from the current year's individuals (about 20-30 cm long) to denuded stipes which represent the final stages of plants probably 3-4 years old. A form of *L. saccharina* (L.) Lamour. formerly considered a separate species, *L. agardhii* Kjellm., is illustrated here. A species similar in general appearance to *L. saccharina*, *L. longicuris* Pyl., has a longer, hollow, and often bent stipe.

- 41 Vegetative portions of thallus dominantly compressed or flattened 42
- 41* Vegetative portions of thallus dominantly cylindrical (or only slightly compressed in restricted areas such as at base of branches) 52
- 42 Plant brown 43
- 42* Plant red 46
- 43 Holdfast of branched root-like structures (haptera) *Laminaria* (Figs. 32 and 33)
- 43* Holdfast in the form of a disk (sometimes slightly proliferating in the case of *Saccorhiza*) 44

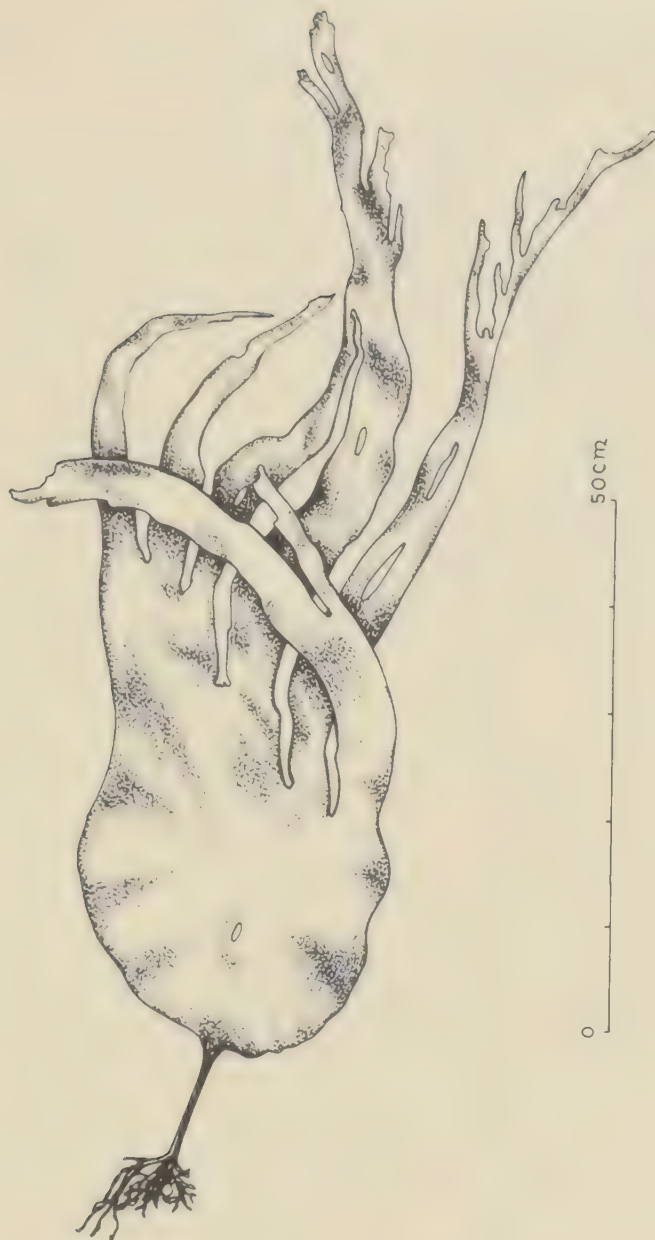


Fig. 33 *Laminaria digitata* (Huds.) Lamour. often occurs scattered among the *L. saccharina* populations. As exposure to increased wind and heavy surf along the shore increases, *L. digitata* becomes more abundant, indicating a greater tolerance to these environmental conditions than *L. saccharina*. The blade of *L. digitata* is conspicuously divided into strap-like segments, the degree of segmentation being rather variable. This species, along with other kelps, are a frequent component of tidal material washed ashore after a storm.

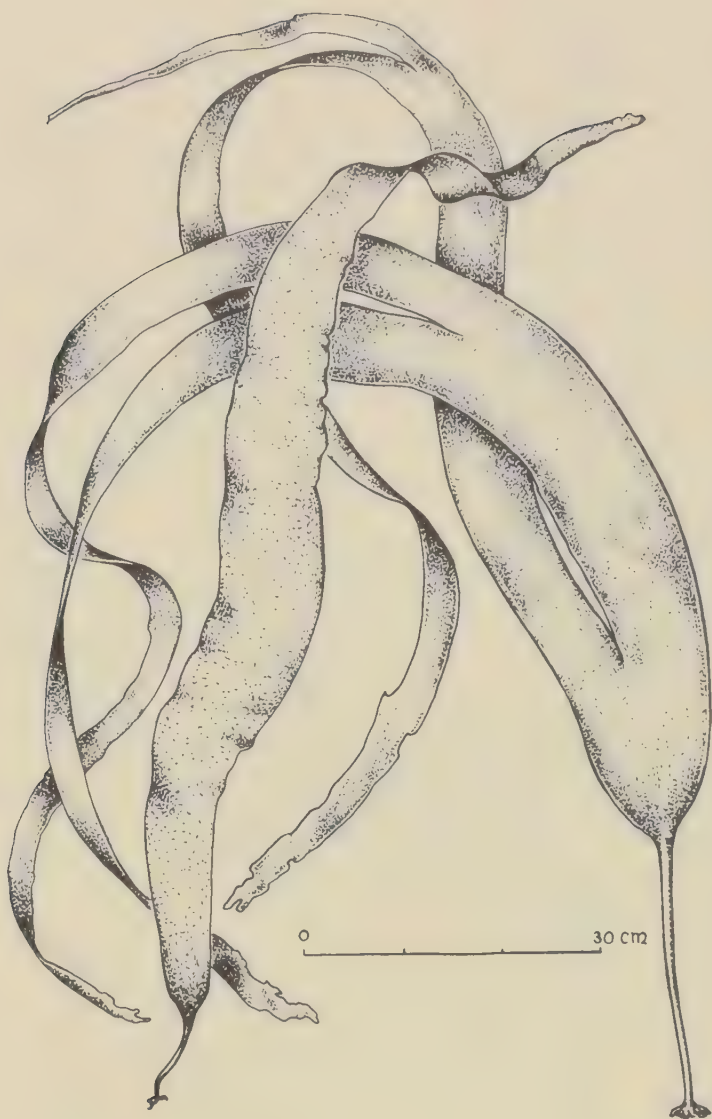


Fig. 34

Saccorhiza dermatodea (Pyl.) Farlow occurs as dispersed individuals among *Laminaria* sp., which it generally resembles both in form and in color. It can be distinguished from these plants, however, by the presence of discoid holdfasts (rather than haptera), by the presence of tiny tufts of hairs on the surface of the blade, and by its markedly flattened stipe.

- 44 Blade large (about 1 m), borne on a laterally compressed stipe *Saccorhiza dermatodea* (Fig. 34)
- 44* Blade small (about 10 cm), not borne on a stipe . . .45
- 45 Thallus, in transverse section under microscope, consisting of $\pm$ uniform-sized cells; surface sprinkled with small spots (minute hair-tufts).
- *Punctaria plantaginea* (Fig. 35)
- 45* Medullary cells in section much larger than surface cortical cells; surface without spots
- *Petalonia fascia* (Fig. 36)

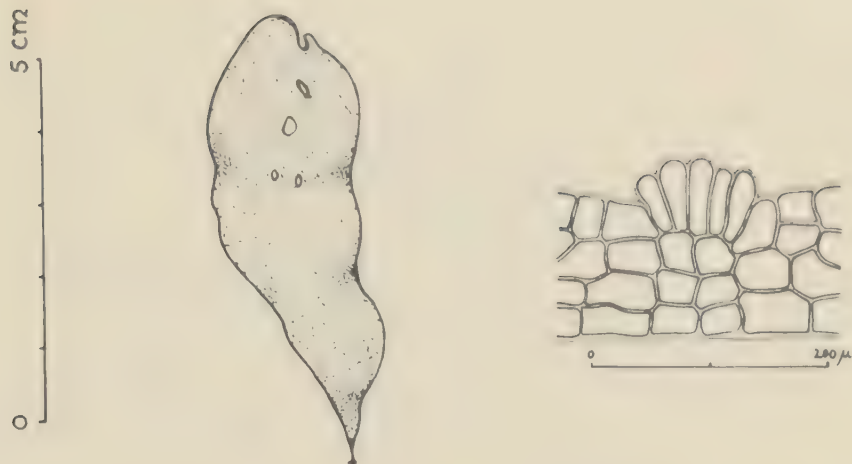


Fig. 35 *Punctaria plantaginea* (Roth) Grev. grows among the kelps in the sublittoral zone. The blade is flat, broad, and undivided, the plants attaining lengths to 15 cm. In cross section and seen with the microscope, all cells in the blade are essentially similar in size. Small tufts of hairs on the blades can be recognized with a hand lens; a section in microscopic view through such a tuft is illustrated.



Fig. 36 *Petalonia fascia* Müll.) Kuntze is a common brown alga on rocks in the low intertidal zone and in tide pools. While this species is most abundant during the colder months, it nevertheless is readily located during the summer. *Petalonia* resembles *Punctaria* but it can be distinguished from it with a hand lens by the absence of the little tufts of hairs. Microscopic examination of a blade cross section shows large central (medullary) cells, with smaller assimilative cells toward the blades' surfaces.

- 46 Branching regularly opposite, in older parts with the opposing branches of different size
 *Ptilota serrata* (Fig. 37)
 46* Branching dichotomous or irregular 47



Fig. 37 *Ptilota serrata* Kütz. is one of the most beautiful of the red algae, whether seen macroscopically in the field or viewed under the microscope. It is recognized easily by its flat, bilateral and opposite branching pattern. One branch of each pair is usually subdivided while the other member is smaller and merely serrated (toothed) along its margin. The plants grow in tufted clusters, are rather stiff, typically 5-10 cm (~15 cm) tall. Larger algae, especially *Laminaria* sp., may provide substrate for *Ptilota*, but the species may also be attached to rocks (epilithic). Large quantities of this alga are usually found cast up on the shore following storms. A detail drawing is shown above, and a shadowgraph at lesser magnification below.

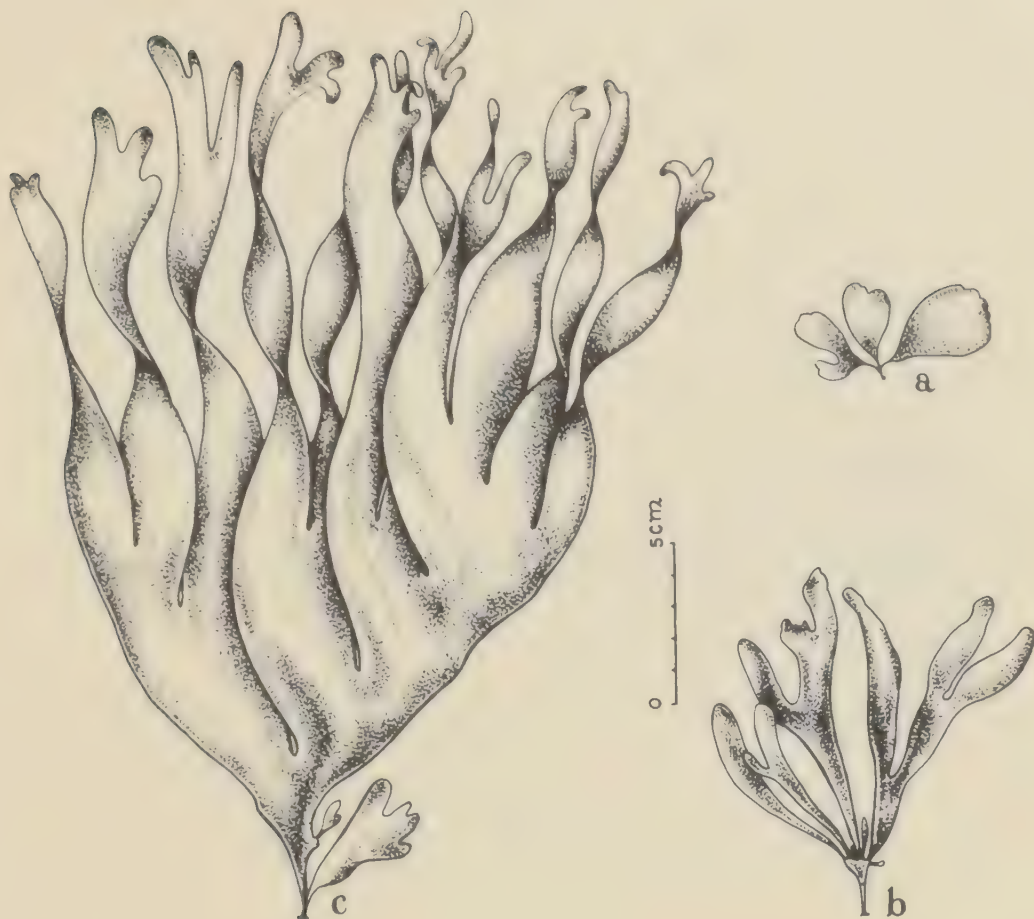


Fig. 38 *Rhodymenia palmata* (L.) Grev. is a very large and "leafy" red alga, rose to deep-red in color, and rather leathery in texture. The blades exhibit dichotomous branching, often with proliferating margins. The plant is common to large, downshore intertidal pools and to the sublittoral, where it grows attached to rocks or to other algae, e.g., *Laminaria stipes*. Dried plants are sold as "dulse" in the stores of New Brunswick and Nova Scotia. Our illustration is of a markedly twisted specimen.

- | | | |
|-----|---|-------------------------------------|
| 47 | Fronds broadly expanded, leaf-like | 48 |
| 47* | Thallus flattened but not broadly expanded or leaf-like | 49 |
| 48 | Plant entirely leafy, large (15 cm or more in length), slightly dichotomously branched or unbranched if small | <i>Rhodymenia palmata</i> (Fig. 38) |
| 48* | Plant of leaf-like terminal blades borne on branched, cylindrical basal stems; plant smaller, 3-8 cm long | <i>Phyllophora</i> (Fig. 39) |



Fig. 39 *Phyllophora* Grev. A few species of this genus, distinguished with difficulty, occur in our northeastern flora. They grow mainly in the sublittoral zone at depths of about 6-10 m, although occasionally they can be found in tide pools. The plants are quite stiff, stalked below, but widening to a narrow blade above. The often twisted axes are usually encrusted with bryozoans. *Phyllophora* species yield a carrageenan of economic importance.

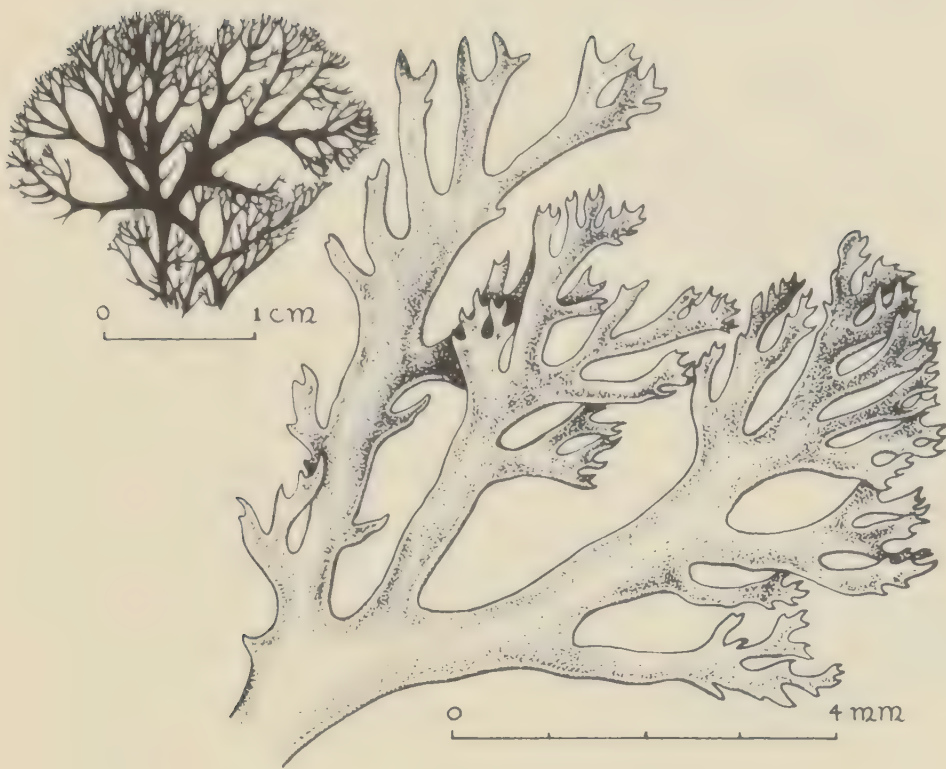


Fig. 40 *Euthora cristata* (C. Ag.) J. Ag. is a plant of bushy habit, 10-15 cm tall, deep red coloration, and very common in the sublittoral. *Euthora* grows on rocks or epiphytic on other algae, e.g. *Laminaria*, *Chondrus* and *Phyllophora*. It can usually be found in tidal drift material. Some authorities refer to this taxon as *Callophyllis cristata* (C. Ag.) Kütz.

- 49 Plant with numerous fine ultimate subpinnate or subdichotomous branchlets not over 1 mm wide; grows only in the infralittoral *Euthora cristata* (Fig. 40)
- 49* Plant with branches clearly dichotomous and at least 2 mm wide; occurs in intertidal belt and in tide pools 50



Fig. 41 *Gigartina stellata* (Stackh.) Batt. occurs on rocks in the lowest intertidal zone, frequently among *Chondrus crispus*. It is light to dark, sometimes becoming yellowish when exposed to excessive light. *Gigartina* resembles *Chondrus*, but it can be recognized by the numerous papillae scattered over the thallus; such structures are lacking in *Chondrus*.

- 50 Surface and margins with scattered wart-like papillae *Gigartina stellata* (Fig. 41)
 50* Surface of thallus smooth, without papillae 51

- 51 Plants often over 5 cm tall, with branches often over 5 mm broad; distinctly flattened almost down to base; medulla vaguely filamentous, not cellular; extremely abundant in intertidal and infralittoral belts, all the year round *Chondrus crispus* (Fig. 42)
- 51* Plants up to 5 cm tall, with branches 2-5 mm broad; cylindrical down near the base; medulla of rounded or angulose cells; rare, in deep tide pools, primarily in fall and winter *Gymnogongrus norvegicus*
(See legend to Fig. 42)
- 52 Plant brown 53
- 52* Plant red or dark reddish (sometimes almost blackish) 60
- 53 Thallus unbranched *Chorda*
(Fig. 4; see also under step 7 of key)
- 53* Thallus branched 54
- 54 Thallus gelatinous, soft *Eudesme virescens*
(See legend to Fig. 42)
- 54* Thallus of firm consistency, not gelatinous 55
- 55 Thallus filamentous, of multiseriate or partly uniseriate filaments 56
- 55* Thallus with a parenchymatous medulla and an outer cortex of small assimilative cells 57
- 56 Thallus forming loose tufts up to about 7 cm long, abundantly branched, not spreading by stolons at the base; filaments not clearly segmented, multiseriate in main branches, uniseriate in final branches; growing on other algae, e.g. *Ptilota* *Isthmoplea sphaerophora*
(See legend to Fig. 42)
- 56* Thallus forming dense tufts to 3 cm long on larger algae, the erect filaments dark brown and sparingly branched; growing in the sublittoral or attached to rocky bottoms of tide pools *Sphacelaria*
(See legend to Fig. 42)
- 57 All branches opposite; plant soon turning green when taken out of the water *Desmarestia viridis* (Fig. 43)
- 57* Branching of main part of thallus alternate; plants not soon turning green when taken out of the water 58
- 58 Ultimate branchlets bilateral, short, spine-like; plant produces in spring pale brown shoots of assimilative hair-tufts with opposite branching
. *Desmarestia aculeata* (Fig. 43)
- 58* Branching multilateral, ultimate branchlets long, not spine-like; plant not producing pale spring shoots. .59



Fig. 42 *Chondrus crispus* Stach., the "Irish moss", is an extremely common red alga all throughout our north-eastern coastal region. Dense populations cover the rocks in the low intertidal and upper sublittoral zones. Plants exhibit morphological variability, but, in general, the flattened axes arise from a stalk-like base and usually are dichotomously branched at their rounded tips. *Chondrus* yields a commercially important colloidal substance called carrageenan (as do *Phyllophora* and *Gigartina*) used in a variety of food products.

Gymnogongrus norvegicus (Gunn.) J. Ag. is similar in general appearance to *Chondrus*, but the plants are smaller, more delicate, and have axes which are round, rather than flattened as in the latter. In addition, *Gymnogongrus* appears to be a rare plant, having been reported once from Massachusetts by Farlow about 80 years ago.

Eudesme virescens (Carm.) J. Ag. is a moderately sized brown alga of rather gelatinous consistency. It is further characterized by the pronounced right angle orientation of its branches. The plants occur attached to eelgrass (*Zostera*) rhizomes, stones, and on large algae.

Isthmoplea sphaerophora (Carm.) Kjellm. This tufted brown alga, rare in occurrence, is generally similar in gross habit to *Pylaiella*. Microscopically, these plants can be distinguished by both vegetative and reproductive features. Taylor (1957) reports it growing on *Ptilota*, and recently it has been found growing sparingly on *Fucus* at Nahant, MA.

Sphacelaria Lyngbye is a brown filamentous alga which will most likely be encountered either as an epiphyte on larger algae, or attached to other substrates such as stones and shells. The plants are small, approximately 1-4 cm tall, and assume a somewhat rounded or tufted growth habit. *Sphacelaria cirrhosa* (Roth) C. Ag. commonly grows on members of the *Fucaceae*, and *S. radicans* (Dillw.) C. Ag. is known to occur on rocks in tide pools.



Fig. 43 *Desmarestia aculeata* (L.) Lamour. grows on rocky substrates in the sublittoral, mixed frequently with *Laminaria* sp. Like many other algae common to this zone, *Desmarestia* is a common component of tidal drift material. In the spring and early summer the axes are clothed in pale brown assimilative filaments. These are shed later in the season, so that by late summer and into the winter plants typically possess rather wiry and short, spinous, dark brown alternately placed branches. The plants are usually to 0.5 m in length, although individuals to a meter or more long are known. Transverse sections of the axes as seen with a hand lens show a small central hole surrounded by densely organized (medullary) tissue.



Fig. 44
Chordaria flagelliformis
 (Müll.) C. Ag. grows in
 the sublittoral and in
 low intertidal pools.
 The plants are dark
 brown, somewhat leathery
 and slippery to the
 touch. They are highly
 branched; the branches
 are longer than the main
 axis. This species is
 especially common during
 the summer, and, like
 many large sublittoral
 algae, is often collect-
 ed from tidal drift. A
 small form of peculiar
 appearance (var. *densa*
 Farlow), shown at (b),
 may be collected on mud
 flats.

- 59 Lateral branches coarse, often exceeding the main axis
 in length; branches always solid; outer cortex formed
 by crowded assimilative filaments
 *Chordaria flagelliformis* (Fig. 44)
- 59* Lateral branches fine, almost capillary, not exceeding
 the main axis in length; main branches occasionally
 becoming hollow; outer cortex of small cells
 *Dictyosiphon foeniculaceus*
 (Fig. 7; see also under step 9 of key)

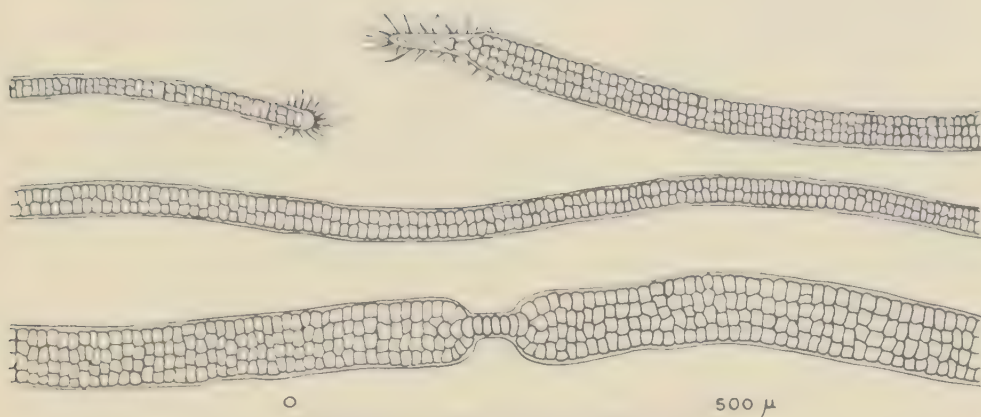


Fig. 45 *Bangia fuscopurpurea* (Dillw.) Lyngbye can be collected from intertidal rocks at and just below high tide level. The plants are unbranched filaments, and form a reddish, fine-textured, hair-like coating over the substrate. During mid to late summer, these massed filaments occur sporadically along the shore, but from September on through the winter, the populations increase to abundance and the plants are very noticeable; maximum growth is during the spring. When wet, these plants assume a very dark red color; when dry, they appear rusty-red. *Bangia* is often associated with the bluegreen alga *Calothrix crustacea* (Thur.) Fan. (Fig. 15).

- | | | |
|-----|--|----|
| 60 | Thallus consisting of matted hair-like filaments, rusty reddish - or purplish-brown, forming a flat coating on intertidal rocks or over barnacles; young filaments uniseriate, older filaments becoming multiseriate . . . | 61 |
| | <i>Bangia fuscopurpurea</i> | |
| | (Fig. 45; see also under step 31 of key) | |
| 60* | Thallus not as above | 61 |



Fig. 46 *Ahnfeltia plicata* (Huds.)
Fr. is bushy in habit, several cm long, the narrow axes (less than 1 mm wide) conspicuously wiry to the touch. This species appears confined to the sublittoral, and is collected only by diving or from tidal material washed up on the beach. *Ahnfeltia* has potential economic value as a good source of agar.

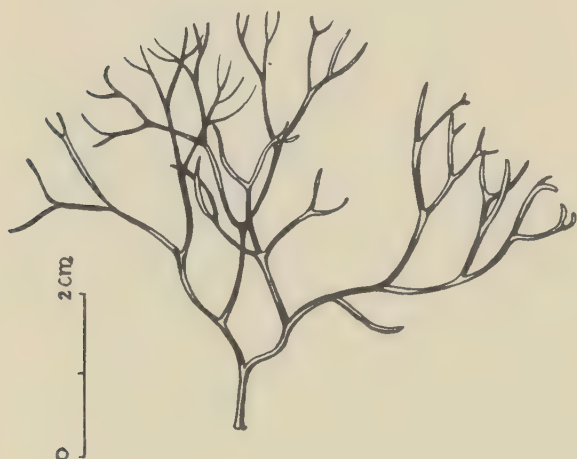


Fig. 47
Polyides caprinus
(Gunn.) Papenf. has a stiff, cartilaginous texture; it is very dark purple-red. Its branching pattern is markedly dichotomous. It is a deep-water species, usually collected only by diving, although it can occasionally be found washed up onto the beach. Growth habit and pigmentation make this alga readily recognizable.

- 61 Plants stiff, wiry or cartilaginous, very dark, often almost blackish 62
- 61* Plants not stiff or wiry, of paler color (light to dark reddish) 63
- 62 Branches less than 1 mm thick; branching dichotomous, unilateral, or quite irregular *Ahnfeltia plicata* (Fig. 46)
- 62* Branches 1-2 mm thick; branching clearly dichotomous *Polyides caprinus* (Fig. 47)

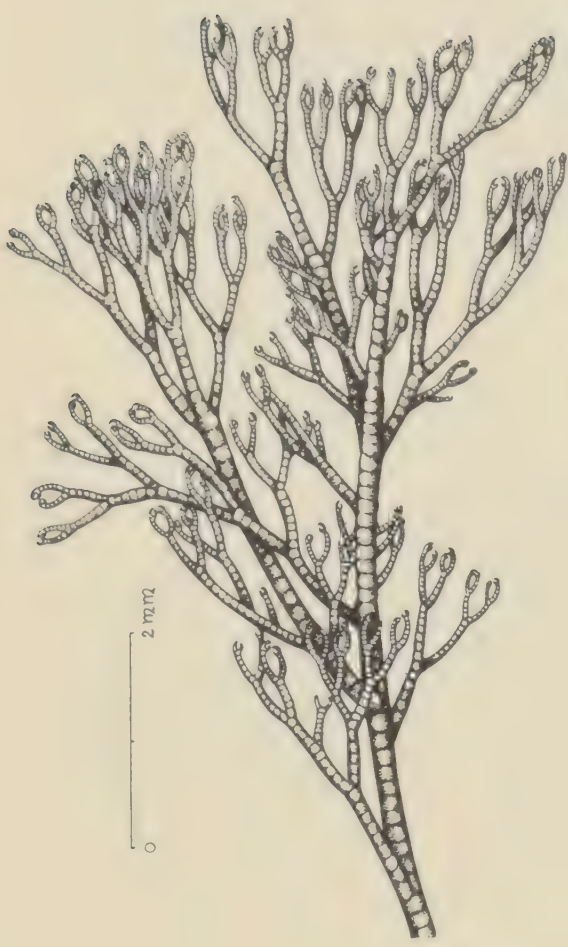


Fig. 48 *Ceramium rubrum* (Huds.) C. Ag. is likely the most commonly encountered species of *Ceramium* within our region, and is illustrated here. The plants exhibit dichotomous branching with the ultimate branch tips forcipate, hence the common name of "lobster claws". This feature, plus the banded appearance of the axes, makes *Ceramium* easy to identify with the aid of a hand lens. *C. rubrum* occurs year round, and can be collected from tide pools, beach drift, etc.; the plants grow on rocks, wood, and on other algae. A quite rare taxon, *C. deslongchampii* Chauv. var. *hooperi* (Harv.) Taylor, occurs from New England northward. This species, like several others in *Ceramium*, exhibits a more pronounced banded aspect than *C. rubrum*, for the corticating (covering) cells occur only where two adjacent axial cells touch. This results in the appearance of ring-like "nodal" red bands of cells alternating regularly with uncovered (non-red) "internodal" cells. Taylor (1957) can be consulted for additional species of *Ceramium*.

- 63 Thallus branches consisting of a central axial row of very large cells externally covered (or partly covered) by annular corticated bands; ultimate branchlets dichotomous, forcipate (resembling lobster claws) *Ceramium* (Fig. 48)
- 63* Thallus branches not as above 64

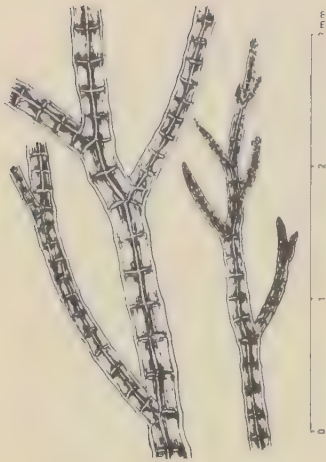


Fig. 49 *Polysiphonia* Grev. Species of this genus may resemble *Ceramium* superficially in that the axes appear somewhat banded. Under magnification one can see that this banding comes about where elongated cells (pericentral cells) abut, these cells further overlying a central axial filament. The number of pericentral cells is rather constant for each species, and so is an important taxonomic criterion. The number is four in the species illustrated here. *P. lanosa* (L.) Tandy, with 20-24 pericentrals, is one of our commonest species; it grows exclusively on *Ascophyllum*. Another common species, *P. urceolata* (Lightf.) Grev., is sublittoral, of fine silky texture, wine to dark red color and has four pericentral cells. Other species are to be found in Taylor (1957).



Fig. 50 *Asparagopsis hamifera* (Har.) Okam. is a bushy red alga encountered in the sublittoral or collected from tidal drift. The plant branches repeatedly, the ultimate branchlets being quite fine, lending a feathery aspect to the alga. Among these small axes occur large sickle-shaped branches, curved and tapering to the tips. These structures make the identification of *Asparagopsis* inescapable. The life history of *A. hamifera* is now known to include a plant formerly described as *Trailliella intricata* (See Fig. 20). The only plant with which *Asparagopsis* could be confused is *Hypnea musciformis* (Wulf.) Lamour. However, the overall growth habit, microscopic details of reproduction, and distinctly separated geographical ranges (except, perhaps in southern Massachusetts) serve to differentiate these two taxa.

- 64 Thallus segmented, with segments consisting of longitudinally elongated pericentral cells grouped around a central axial filament *Polysiphonia* (Fig. 49)
- 64* Thallus not segmented, uniformly covered with a cortex of cells or compacted assimilative filaments (some *Polysiphonia* species have the pericentral cells slightly obscured towards the base of the thallus by a rudimentary development of cortical cells) 65
- 65 Branches with occasional hamate (hook-like or sickle-shaped) structures . . . *Asparagopsis hamifera* (Fig. 50)
- 65* Branches without such structures 66

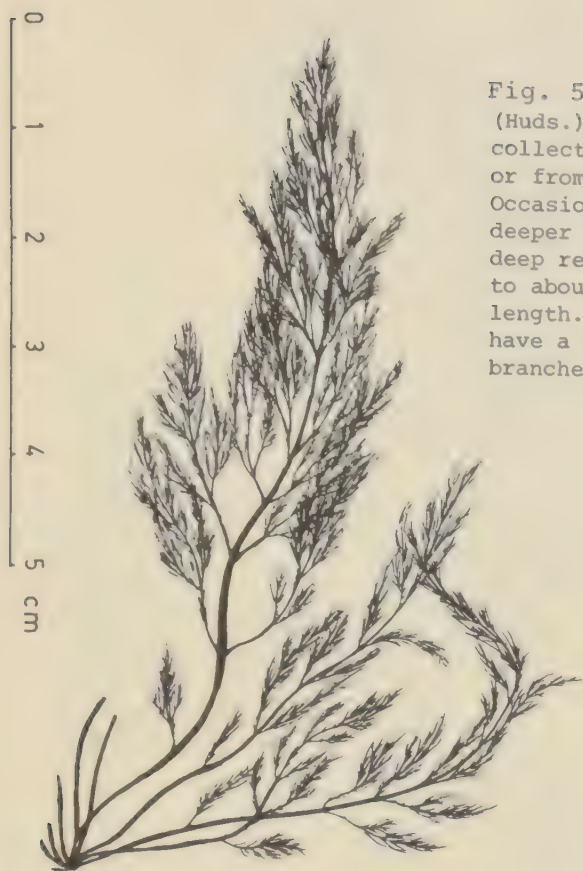


Fig. 51 *Gloiosiphonia capillaris* (Huds.) Carm. This red alga can be collected from the sublittoral zone or from tidal drift on the beach. Occasionally, it can be located from deeper tide pools. The plants are deep red, bushy in habit, and grow to about a foot (maximally) in length. When handled, the plants have a gelatinous consistency; the branches taper markedly at both ends.

- 66 Plant of soft gelatinous consistency; outer cortex of crowded and conglutinated assimilative filaments *Gloiosiphonia capillaris* (Fig. 51; see also under step 10 of key)
- 66* Plant of firm consistency, not gelatinous; outer cortex cellular with small cells 67
- 67 Ultimate branchlets usually brush-like (penicillate); medulla entirely parenchymatous . . *Rhodomela confervoides* (Fig. 52)
- 67* Ultimate branchlets not brush-like; medulla parenchymatous with a central loose core of longitudinally-oriented filaments . . . *Cystoclonium purpureum* (Fig. 53)



Fig. 52 *Rhodomela confervoides* (Huds.) Silva. A plant typical of rocky habitats where it grows strictly in the sublittoral. Superficially, this species bears some resemblance to *Polysiphonia*, but it is not segmented. *Rhodomela* axes branch profusely at their tips, giving the plant a brush-like (penicillate) aspect during the winter and spring months. Summer plants customarily shed these tufted branches, however.



Fig. 53 *Cystoclonium purpureum* (Huds.) Batt. occurs on rocks in the sublittoral. These bushy plants may reach lengths to 50 cm; all axes are cylindrical in shape. Coloration in healthy individuals varies from deep red to a brown-black. The branching pattern tends to be more abundant distally on the axes, and the smaller branches characteristically taper at both ends. Frequently, some of the ultimate branches exhibit a coiled configuration; an extreme state of this condition is called var. *cirrhosum* Harv. *Cystoclonium purpureum* f. *stellatum* Collins first described from Maine, possesses bur-like growths randomly distributed throughout the plant. These structures are considered by some as growth responses by the plant to a bacterial or fungal pathogen. The environmental factors which result in the expressions of var. *cirrhosum* and f. *stellatum* remain to be determined.

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Zostera marina L. (Eelgrass, grass-wrack) is not an alga but a flowering plant. It is very common on the Atlantic coast and elsewhere, growing on sandy bottoms at depths of five meters or more. These plants are often referred to as "sea grasses". Although they superficially look like grasses, they do not belong to the Gramineae, but to another monocotyledonous family, the Zosteraceae.

